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XUM

THE

JOURNAL OF SCIENCE.

DECEMBER, 1883.

I. EARTHQUAKES AND ELECTRICITY.

By Colonel ARTHUR PARNELL, late Royal Engineers.

ON a beautiful starlight evening towards the close of July, 1883, some two thousand Italians, residing or temporarily staying in a pleasant island in the Bay of Naples, were suddenly summoned to render up their lives. By a sharp convulsion of the earth's surface the tall masonry houses of Ischia were in a few seconds transformed into the tombs of a great company of men, women, and children, whose souls passed to the nearer presence of their Creator through the medium of one of the most agonising and pitiable deaths that it is possible to conceive. Are we to look on this heart-rending event as simply a random wanton freak of Nature? Or are we to consider it as a lesson especially directed to men of education and science, to teach them that the terrible physical plagues known as earthquakes are occurrences that need the most earnest investigation and reflection, with the view of haply lighting on the means of preventing them? Is the signal success that attended Jenner's efforts to avert the dreadful pestilence of smallpox to be consigned to dark oblivion? Or shall we endeavour to follow his footsteps by carefully examining the conditions and effects of earthquakes, in the hope of discovering their cause?

Within the limits of a brief paper like the present one scope does not exist for dealing exhaustively, or even fully, with the various circumstances—physical, meteorological, and geographical—that permeate and environ the great subject of earthquakes. But the writer trusts to be able to

throw perhaps a few gleams of light along a short distance of a path that may possibly, if patiently explored, eventually lead to the desired goal.

In a very interesting article on "Earthquakes; their Cause and Origin," that appeared in the "Quarterly Review" for July, 1881, the author (whose name is unknown to the present writer) mentions the following theories as the principal ones that have from time to time been enunciated as probable causes of these phenomena :—

1. Water expanding into steam on coming into contact with subterranean lava.
2. Chemical changes or combinations within the earth.
3. The shrinking and cooling of the earth's crust.
4. Rupture by tension.
5. Collision between solids and a liquid.
6. The passage of a wave of elastic compression causing each particle of earth to perform a vibratory movement.
7. An incomplete effort to establish a volcano.

But in the opinion of the reviewer the cause of earthquakes was attributed to electricity, and his paper contained strong arguments in favour of this idea, though no allusions were made to the writings of previous advocates of the electrical theory. The present writer is equally impressed with the belief that electricity is the true source of earthquake phenomena, and he had already published his views on the matter (in connection with thunderstorms) before he was aware of the existence of another worker in the same field; and he now proposes to submit a slight historical notice of some of the suggestions that have at different times been advanced in connection with the association between earthquakes and electricity.

The most ancient allusions to the subject are probably those contained in the Scriptures. After the arrival of the children of Israel in the wilderness at the foot of Mount Sinai, on their journey from Egypt to Canaan, "it came to pass on the third day in the morning that there were thunders and lightnings and a thick cloud upon the Mount, and the voice of the trumpet exceeding loud; so that all the people that was in the camp trembled. And Moses brought forth the people out of the camp to meet with God; and they stood at the nether part of the Mount. And Mount Sinai was altogether on a smoke, because the Lord descended upon it in fire; and the smoke thereof ascended as the smoke of a furnace, and the whole Mount *quaked*

greatly" (Exodus xix., 16—18). We thus see how the giving of the Old Law to the chosen people was ushered in by grand physical manifestations; and the thunderstorm and earthquake which they included would appear to be intimately combined in one common source.

Now let us turn to a very different portion of the Holy Writ—to scenes of exquisite imagery foreshadowing by sign and metaphor the eve of a New Law and of a new order of things:—"I saw the seven angels which stood before God; and to them were given seven trumpets. And another angel came and stood at the altar, having a golden censer; and there was given unto him much incense that he should offer it with the prayers of all saints upon the golden altar which was before the throne. And the smoke of the incense which came with the prayers of the saints ascended up before God out of the angel's hand. And the angel took the censer and filled it with fire of the altar, and cast it into the earth; and there were voices and thunderings and lightnings and *an earthquake*" (Rev. viii., 2—5). Again, "The seventh angel sounded, . . . and the temple of God was opened in heaven, and there was seen in his temple the ark of his testament; and there were lightnings and voices and thunderings and *an earthquake* and great hail" (Rev. xi., 19). And again, "The seventh angel poured out his vial into the air; and there came a great voice out of the temple of heaven from the throne, saying, It is done. And there were voices and thunders and lightnings; and there was *a great earthquake*, such as was not since men were upon the earth, so mighty an earthquake and so great" (Rev. xvi., 17, 18). It seems impossible to doubt that the Inspirer of these three passages looked on lightnings and earthquakes as being branches of one and the same agency.

Descending now to secular history we find the following remarkable extract from Pliny's writings, quoted by Alexander Von Humboldt in his famous "Cosmos":—"Ventos in causa esse non dubium reor. Neque enim unquam intremiscunt terræ nisi sopito mari cæloque adeo tranquillo ut volutus avium non pendeant, subtracto omni spiritu qui vehit; nec unquam nisi post ventos conditos scilicet in venas et cavernas ejus occultu afflatu. Neque aliud est in terra tremor quam in nube tonitrum; nec hiatus aliud quam cum fulmen erumpit, incluso spiritu luctante et ad libertatem esire nitente."—(Humb., I., 193; Plin., II., 79.) In this last sentence the co-ordination of thunderstorms and earthquakes is clearly recognised. And whilst in ignorance of

the existence of the force of electricity, it is by no means unreasonable that the frequent occurrence of earthquakes immediately after a period of sultry atmospheric calm should have originated the idea suggested in the first sentence, that they were caused by the bursting forth of the imprisoned winds. (After all, who knows even now but that winds may in some respect be due to electrical action?)

In modern times it would appear that Dr. Stukeley was the first person who advanced the view that earthquakes were probably caused by electricity. This was on the occasion of the earthquakes that happened in 1749 and 1750, at London and at Daventry (in Northamptonshire) respectively. Stukeley's papers were read before the Royal Society on March 22nd, 1749, and on December 2nd, 1750. He shows that during these years thunder, lightning, auroræ, and meteors had been remarkably prevalent throughout England, and the whole of his arguments are well worthy of study. But whilst Stukeley was thus urging this theory a philosopher in the South of Europe was at the same time, and without any knowledge of Stukeley's labours, proceeding on the same course. This southern physicist was a native of Turin and a Roman Catholic priest. His name was Giambattista Beccaria. In 1753 he wrote "Dell Elettricismo artificiale e naturale," and in 1758 "Lettere dell Elettricismo." If the theory of the electrical origin of earthquakes should ever gain acceptance it is to this great man that the honour should be awarded. Of him the following remarkable testimony is given by his contemporary, the well-known Dr. Priestley:—"All that was done by the French and English electricians with respect to lightning and electricity fell far short of what was done by Signor Beccaria at Turin" (Hist., 315). Again, in regard to experiments made by *savants* for ascertaining the electricity in the air, "Signor Beccaria made, however, the most extensive and accurate experiments on this subject" (Hist., 338). And again, in connection with the heterodox views of Mr. Wilson regarding pointed lightning-rods, he alludes to Signor Beccaria as one "whose observations and experience with respect to lightning give a weight to his opinion superior to that of any man whatever" (Hist., 373): and this he writes at a time (1775) when Benjamin Franklin was, so to speak, in the zenith of his physical fame. Beccaria appears to have made experiments and researches on terrestrial electricity for a period of some twenty-five or thirty years, and he became firmly rooted in the belief that not only were lightning-strokes (or thunderbolts) due to the earth's electricity, but

that also earthquakes, auroræ, and whirlwinds were derived from the same cause. It is most noteworthy that he, one of the great pioneers of electricity, one of the men who attended at its birth,—the man who above all his fellows minutely searched into its operations and effects in regard to Nature, and the man who, of all the great labourers in the electrical vineyard (living as he did in Italy, a land which, probably far beyond other European lands, gives facilities to the natural philosopher for studying the action both of the thunderbolt and of the earthquake), had the greatest natural opportunities for arriving at the truth,—should have thus deliberately recorded his convictions respecting the electrical source of earthquakes. And it is equally remarkable that these convictions should have been deliberately rejected by almost every one of his contemporaries and successors. For to this day there is hardly a scientific man in Europe who entertains even Beccaria's view as to the earth-sprung nature of *lightning-strokes*. How then can we expect that, in the absence of this essential preliminary step, the whole development of Beccaria's theory could ever have been adopted?

We have already drawn attention to a great English philosopher of those times, *viz.*, Dr. Joseph Priestley, F.R.S., who wrote "The History and Present State of Electricity, with Original Experiments, the fourth edition of which appeared in 1775. On the mind of Priestley the researches and opinions of Beccaria had evidently made a strong impression, and it was in no faltering spirit that Priestley supported the views of his great master. The "Queries and Hints" on terrestrial electricity modestly propounded by Priestley are of a very pregnant nature. He says, "May not the void space above the clouds be always occupied with an electricity opposite to that of the earth? And may not the thunder, earthquakes, &c., be occasioned by the rushing of the electric fluid between them whenever the redundancy in either is excessive? Is not the Aurora Borealis, and other electrical meteors which are remarkably bright and frequent before earthquakes, some evidence of this?" . . . "Is not the earth in a constant state of moderate electrification?" . . . "And is it not probable that earthquakes, hurricanes, &c., as well as lightning, are the consequences of a too powerful electricity in the earth?" . . . "Supposing earthquakes to be caused by the discharge of a redundant electricity from the surface of the earth, might they not be prevented in countries subject to them by kites flying very high, with wires in the strings so as to promote an easy

communication between the earth and the upper regions of the atmosphere?"—(Hist., 459.)

The next English writer to advert to the question appears to have been William Nicholson, who in 1787 wrote "An Introduction to Natural Philosophy." He adduces experience to combat the idea that earthquakes can be occasioned by subterranean explosions. But apparently he alludes to explosions of *vapour*, for he mentions the notion as "the common opinion." His notice is valuable as tending to show one of the possible reasons for the rejection, by the physicists of those days, of the theory of an electrical origin; for doubtless the only action they would conceive to result therefrom would be that of a subterranean explosion somewhat akin to a subterranean explosion between two clouds. Since, however (as Nicholson shows) facts demonstrated that the operation of earthquakes was chiefly of a *superficial* nature, the upheaval of the ground that must inevitably attend an explosion from below was probably deemed to be by no means in accordance with observation, and the electrical theory was therefore discredited. But to physicists of the present day conversant with the important class of electrical discharges known as *leaks* the surface nature of the action of earthquakes would appear to present a stamp of confirmation, rather than a stumbling-block.

A long interval now ensues, and Humboldt's "Cosmos" would seem to be the next important work that dealt with the question. The English translation (by Colonel, afterwards Sir Edward, Sabine, F.R.S.) of this "Sketch of a Physical Description of the Universe" was published in 1847. Besides the quotation from Pliny to which we have already alluded, much valuable information on the subject of earthquakes is furnished by Humboldt. He says:—"Active volcanoes may be regarded as safety-valves for the country in their immediate vicinity" (i., 202). . . . "The destruction of Lisbon, of Caracas, of Lima, of Cashmeer in 1554, and of so many towns of Calabria, Syria, and Asia Minor, shows that on the whole the most violent shocks do not usually take place in the vicinity of still active volcanoes" (i., 202). In allusion to the substances ejected at times from the earth—such as hot water, steam, noxious gases, mud, smoke, and flames—he says, "Do gaseous fluids issue from the interior of the earth and mingle with the atmosphere? Or are these meteorological processes the effects of a disturbance of the electricity of the atmosphere by the earthquake?" (i., 205). In regard to the association of earthquakes with thunderstorms he says, "On the coasts

of Peru, where rain scarcely ever falls, and where hail, lightning, and thunder are unknown, these atmospheric explosions are replaced by the subterranean thunder which accompanies the trembling of the earth" (i., 205). Lastly, in respect of the probable affinity between the heat, electricity, and earthquakes:—"If, on the one hand, the internal heat of our planet may be connected with the excitement of electro-magnetic currents and the evolution of terrestrial light (auroræ) accompanying a magnetic storm, it is also a principal source of geological phenomena" (i., 189).

A great name in seismological literature now claims our recognition. To the late Mr. Robert Mallet, F.R.S., Science is much indebted for his magnificent record of the earthquakes that have occurred between B.C. 1606 and A.D. 1850—a list that comprises no fewer than 6831 instances of terranean convulsion. This account, together with most of his researches in the field of earthquake physics, is contained in various Reports made to the British Association during the years 1850 to 1854 inclusive. Hereafter we shall present a selection from Mallet's incidents; let us now notice some of his *dicta*. In regard to particular shocks which have caused fissures to open in the earth, and fire and smoke to issue therefrom, he says:—"The experiments of Becquerel and other electricians have shown that when fracture in a solid takes place a powerful electrical disturbance is the consequence. This will be great in proportion as the surface and mass fractured are in themselves large. When therefore a fracture of a mile long and of many feet in depth is formed, . . . the disturbance of electric equilibrium may be expected to exceed that of a heavy thunderstorm, and may *quoad* this part of earthquake phenomena realise the dreams of the older philosophers who thought that an earthquake was a thunderstorm under ground. In this then I believe is to be found the usual source of the flame or flash seen suddenly to appear and vanish at the mouth of the rent" (First Report, p. 54). He thinks that the smoke observed is probably in all cases *dust*. On the subject of the *malaise* that frequently (as with thunderstorms) precedes earthquakes:—"Animals, including pigs, oxen, horses, mules, dogs, geese, poultry, show presentiments of coming shocks by their uneasy manner. Human beings have sometimes a tendency before shocks to giddiness, headache, and nausea" (First Report, p. 68). He quotes Von Hoff in the following important passage:—"In all relations between this earth and its atmosphere the former is to be considered as the principal and the latter only as its appendage. The atmosphere is

the child of the earth, and is supported by it" (First Report, p. 71). And again, in respect of the correspondence between earthquakes and terrestrial magnetism, Von Hoff *loquitur*:—"In many instances in which an opportunity of observing the magnetic needle during an earthquake has presented itself an alteration in its direction for the time has been observed." . . . "More remarkable, however, are the changes in the direction of the dip and variation needles, which take place at a distance from the place where the earthquake was observed, and at a place where the shock itself is not perceptible; as, for instance, in Paris on the 19th February and 31st May, 1822, simultaneously with an earthquake which occurred in Savoy and some of the southern parts of France. If this observation should be established by others carefully made, the existence could not be denied of a connexion between terrestrial vulcanism and terrestrial magnetism." Mallet himself supplies the following remarkable conception:—"Thus, then, ignorant as we are of all within the outer surface or skin of our globe (and of how much of its exterior, for the ocean shrouds two-thirds of it from our eyes?), we are compelled to see the close connexion of these mighty heating powers in which ignition is present on the vastest scale, yet without combustion, with the forces of terrestrial electricity and magnetism, forces which are those alone that within range of our observation are mutually convertible and both convertible into heat. Currents of both we know are ever passing, with variable activity, through enormous volumes of the earth's crust, the different parts of which possess very different conducting powers. Can it be that these currents, constrained to pass through narrow and bad conductors at vast depths in some formations, ignite them in their progress? Will it be found that the great lines of volcanic activity (as dreamed by Bylandt) are in some way connected with those of terrestrial magnetism?—are possibly normals to the surface curves of equal magnetic intensity? A glance at one of Gauss's magnetic maps, and at another of the great bands of active volcanoes on our planet, almost forces the mind into such conjectures" (First Report, p. 77). Yet this brilliant speculation seems to have fallen entirely to the ground, for the author of it consistently attributed the cause of earthquakes either "to the sudden formation of steam from water previously in a state of repulsion from the heating surfaces" (First Report, p. 80), or "to the passage of a wave of elastic compression causing each particle of earth to perform a vibratory movement" (Quart. Rev., July, 1881).

In the British Association Report for 1851 is a communication by Mr. R. Budge, F.R.G.S., regarding the great earthquake which took place in Chili during his residence there in that year. After describing the various circumstances of the event, he states that he cannot understand earthquake phenomena unless electricity be the agent (B. A. R. 1851, p. 85). In the same Association's Report for 1852 the well-known Dr. Buist, of Bombay, in a letter to Prof. Baden Powell, F.R.S., dated July 24th, 1852, says, "It is now well established that in India, at all events, earthquakes are almost always accompanied by furious storms of thunder, lightning, and rain; it is difficult to trace the cause of coincidences so remarkable in the commotions of the earth and the air" (B. A. R. 1852, p. 239). Again, in this Association's Report for 1864, the Rev. E. B. Ellmar describes a shock that occurred at Lewes, in Sussex, on the 21st August, 1864, and was preceded by copious showers (after three months of drought), accompanied by a great wave from N.W. to S.E., and followed by a thunderstorm, with vivid lightning, much hail, and two waterspouts. He then quotes a letter from Dr. Nicholson, of Tramfield, who says that he has frequently experienced shocks in the West Indies after a long drought, and that he is inclined to attribute some of these shocks to electricity as propounded by Dr. Stukeley (B. A. R. 1864, Trans. 16).

In his "Heat considered as a Mode of Motion" (1863) Prof. John Tyndall, F.R.S., quoting Prof. Dove, of Berlin, in regard to the earthquake at Caracas, of March 26th, 1812, graphically depicts Pliny's idea of a force imprisoned beneath the surface of the earth, and struggling to obtain freedom. "March 26th, 1812, began as a day of extraordinary heat in Caracas; the air was clear, and the firmament cloudless. It was Green Thursday, and a regiment of troops of the line stood under arms in the barracks of the Quarter San Carlos ready to join in the procession. The people streamed to the churches. A loud subterranean thunder was heard, and immediately afterwards followed an earthquake shock so violent that the church of Alta Gracia, 150 feet in height, borne by pillars 15 feet thick, formed a heap of crushed rubbish not more than 6 feet high. In the evening the almost full moon looked down with mild lustre upon the ruins of the town under which lay the crushed bodies of upwards of 10,000 of its inhabitants. But even here there was no exit granted to the elastic forces underneath. Finally, on April 27th, they succeeded in opening once more the crater of Morne Garou, which had been closed for a century;

and the earth for a distance equal to that from Vesuvius to Paris rung with the thunder-shout of the liberated prisoner" (p. 172).

The anonymous writer of an article in "Blackwood's Magazine" for July, 1869, entitled "A New Theory of Earthquakes and Volcanoes," must now be noticed. The "new" theory advanced is the electrical origin of earthquakes; and the writer had evidently neither heard of the labours of Stukeley and Beccaria, nor had he examined the writings of Mallet, Humboldt, and Pliny. The paper is, however, of great interest, and the following are some of the author's conclusions:—"It is the earth which is the chief cause of all our thunderstorms." . . . "The atmosphere plays a secondary *rôle* compared with the solid earth." . . . "It is the condition of the earth's crust which forms the main element of electrical action." . . . "We may aptly describe earthquakes as thunderstorms in the earth." . . . "Volcanoes are vents which the subterranean electric action makes for itself, or for its effects, in those regions or localities where it is strongest or most permanent."

(To be continued.)

II. ON THE THEORY OF PHOSPHORESCENCE.*

By Br. Radziszewski.

In a former investigation on the phosphorescence of organic and organised bodies, the author arrived at the conclusion that various organic bodies become luminous when they combine with active oxygen in presence of an alkali. All bodies whose luminosity has been tested, amounting to several hundreds, can be divided into two groups:—

1. Such as on the addition of an alkali become luminous when they already contain active oxygen, which is formed in them under the influence of an exciting agent,—*e.g.*, sun-light.

* Read before the German Chemical Society.

2. Such as on the addition of alkalies form active oxygen and become phosphorescent during their combination therewith.

To the first group belong various hydrocarbons, the terpenes, &c. Some of these bodies at once give off light when exactly neutralised with barium peroxide, magnesia, milk of lime, or a strong solution of potassa, soda, or even sodium carbonate. They phosphoresce with especial beauty if heated with dry caustic potassa or soda, as is shown by the author's experiments with the oils of amber, calamus, and dill.

In the second group we find various aldehyds (chiefly polymerised), their ammonium compounds,—further, hydrobenzamide, lophine, anisidine, furfurine, and many other analogous bodies. In short, there belong here either aldehyds or bodies which reproduce aldehyds on treatment with alkalies, as the author has already proved in case of lophine.

These bodies, however, are not luminous in watery solutions, even if they are readily soluble in water; they must be treated with alcoholic solutions of alkalies only. This fact attracted the author's attention some time back, though he did not make it public until his researches on lophine had shown that this compound, in presence of water and in the absence of air, attracts the elements of water, and is converted into benzoic acid and oil of bitter almonds. In order to explain this fact the circumstance must not be overlooked that aqueous solutions of potassa form with the aldehyds chiefly resinous matters, whilst alcoholic solutions yield salts of the corresponding acids and alcohols.

The action is therefore twofold, and the process resolves itself into two stages. When the hydrogen which is at first liberated comes in contact with atmospheric oxygen, the latter is at once transformed into the active modification, and then follows the chemical process which gives rise to phosphorescence. Whether this activation of oxygen takes place at once according to Hoppe-Seyler's formula, or if hydrogen peroxide is first formed, is perfectly indifferent as regards the chemical act of phosphorescence, for hydrogen peroxide must first eliminate oxygen if the oxidation of the aldehyd is to take place.

In the author's memoir on the luminosity of fats, such as olive and almond oils, cod-liver oil, &c., he has shown that even when these bodies no longer phosphoresce, if briskly shaken the addition of a few drops of hydrogen peroxide is

sufficient to reproduce the luminosity. In the same category as the phosphorescence of the aldehyds falls the observation of Lachowitz on the phosphorescence of phenanthraquinon in an alcoholic solution of potassa. Here there is first formed an aldehyd-like body which behaves like the aldehyds in general.

It is very probable that fats containing the glycerides of the acids $C_nH_2 - 2O_2$ activate oxygen in the same manner. It is known that ricinoleïc easily yields œnanthyl-aldehyd; but the acids of the general formula above mentioned yield, with potassa, salts of two distinct acids, whilst hydrogen is set free. It is possible that under the influence of an alcoholic solution of potassa these acids attract the elements of water, and form—even at low temperatures—salts of the fatty acids and aldehyds.

The aldehyd thus formed undergoes in its nascent state a further action of the alkalies. Whether this mode of the activation of oxygen can be always identified with the origin of active oxygen in the living organism cannot be positively asserted. Still it is probable that such processes really occur in the living organism, since in it we find bodies of an aldehyd-like nature, fats, &c., and alkaline bodies which may play the same part as potassa. Such alkali may also be able to act in other media as it would in an alcoholic solution.

The question remains still open whether the activation of oxygen by hydrogen is the sole or the main mode of such activation in organisms?

Nencki replies to this question in the negative, and Schmiedeberg puts forward a new hypothesis of physiological combustion, regarding the assumption of the origin of active oxygen in the organism as needless, and calling attention to the influence of the tissues upon the bodies undergoing oxidation. From Schmiedeberg's experiments it appears that within the tissues oxidation proceeds much more rapidly than without them. Prof. Radziszewski, however, remarks that—

1. If we pour into a narrow test-tube a luminous solution of lophine it is most brilliant where it touches the glass, and here the oxidation is strongest. The condensation of gases, and consequently of oxygen, upon the surface of solid bodies, which is still more marked in capillary tubes, has a favourable influence upon the rapidity of oxidation.

2. When fluids come in contact with each other in very narrow openings, slits, &c., there arise electro-capillary currents.

The author refers here to the experiments of Becquerel, who proved that sodium sulphide and copper sulphate, on meeting in very narrow slits, formed not copper sulphide, but metallic copper.

Whether oxygen, dissolved or in unstable combination when passing through capillary vessels, may, under the influence of the electro-capillary current, be capable of causing phosphorescence can only be proved by further experiments.

Some of the above questions having a direct bearing upon phosphorescence were studied by the author during the spring of 1881, at the Naples Aquarium, where he had the opportunity of examining several hundred specimens of *Pelagia noctiluca*, *Beroe ovatus*, &c.

The results of his experiments may be summed up as follows:—All the animals examined had an alkaline reaction, but the base which occasions this alkalinity could not be isolated. From the purified alcoholic extract of *Pelagia noctiluca* he succeeded once in obtaining a precipitate with gold chloride, but it underwent decomposition during re-crystallisation. The luminous substance of *Pelagia noctiluca* is evidently a fat. The residue from the evaporation of 180 specimens of *Pelagia noctiluca* was extracted with ether, and yielded a body having the following properties:—It is a syrupy, slightly yellowish, neutral liquid, easily saponified by alkalies. If kept for some time under the exsiccator it becomes harder, and almost assumes the consistence of butter. It is sparingly soluble in alcohol, readily in ether, but absolutely insoluble in water. If mixed with neurine or potassa this fat gives, when shaken, phosphorescent flashes. Living specimens of *Pelagia noctiluca* behave in the same manner. In the Lazulite Grotto, in the Isle of Capri, the author saw thousands of specimens floating upon the surface of the sea. When undisturbed they were not luminous, but if excited by throwing them from the one hand to the other they gave off phosphorescent flashes, similar in colour and intensity to those obtained from the fat above mentioned.

Finally, to prove the presence of active oxygen, the author used plates of plaster and clay, burnt and soaked in potassium iodide and starch-paste, tincture of guaiacum, &c. As Panceir had proved that the epithelial cells are the seat of the luminosity, either the entire animal or the luminous surface, prepared as quickly as possible, was laid upon the plates. The results were in every case affirmative. It must, however, be mentioned that the well-known colour reaction was produced most distinctly at the margin of and

beyond the contact surface of the animal body, and were fairly visible at those parts of the plate which were in direct contact with the body.

III. DIETETIC REFORMS.

WHETHER owing to the intensified struggle for existence or to the struggle for notoriety, our food and drink are now being scrutinised with abundance of learning, but too often also with a plentiful lack of common sense and practicality. Most of the reformers agree in telling us that the table habits of our forefathers, as well as of ourselves, are entirely wrong; but when they pass from negation to affirmation the doctors differ to an alarming extent.

Some time ago the so-called Temperance Movement—the condemnation and rejection of alcoholic beverages—seemed a sufficiently startling innovation. But now liquids which the original teetotallers imbibed without scruple are called in question, and denounced as little better than beer or spirits. Tea and coffee are especially obnoxious to the innovators. We are told that to their use is owing—in part at least—that increase of nervous affections which overcloud modern life.

In a book which lies before us it is stated that "we should never take fluids with our food, but make it moist with the saliva, masticating it thoroughly, and enjoying the taste. If we moisten it with drinks the saliva will not come so freely, and in this way we lose one of the best helps to digestion."

A breakfast is then described upon the reform principle. "So we began our breakfast, Edith and I, each with a great luscious peach, the last of which we cut into a cup of bread and milk. Then with the green-corn omelette came a dish of stewed green grapes. They were as pink and racy as stewed pie-plant [?] or green currants, and decidedly appetising." Now this might doubtless be a very pleasant breakfast, but, except in warm climates, it is within the reach of the "upper ten" only, and even for them not at all

seasons of the year. Peaches preserved in tins are often deficient in flavour, and their acid juices—like those of all fruits—are certain to act upon the tin-plate and solder, extracting therefrom a dose of lead. Hence we must pronounce this breakfast, for England at least, an impracticability. Tea and coffee are certainly open to grave objections; but they can be stored for use, and obtained in all seasons and in all climates, and render the use of certain solids possible which would have otherwise to be set aside. Banish tea and coffee, and bread and butter follow them,—not perhaps a grievous loss, considering of what modern butter is composed.

Another authority recommends for breakfast "simple vegetable food, which must have thorough mastication. No drink during the meal or immediately afterwards." We might here ask how many kinds of vegetable food, obtainable at all times of the year, are sufficiently juicy to be got down without accompanying drinks in the short interval of time which modern industrialism allows for meals? The factory-worker may take with him in the morning his coffee or tea and sugar in a can, and at breakfast-time can easily obtain a supply of boiling water; but imagine him having to cook a breakfast of cabbage, turnips, or carrots! Or suppose his wife having to prepare such a meal in the morning, and send it to him to the workshop without its becoming cold! Even in much higher positions of life a vegetable breakfast would not be obtainable without great disarrangement of the household. At most hotels the traveller would be advised to seek his reformed breakfast elsewhere.

In short, before the opponents of tea and coffee can expect to make much headway, they must find some substitute equally convenient and capable of fitting in with the wants of the times.

It must not be forgotten that long before tea and coffee made their appearance in Western Europe breakfast was not a dry meal. The bread and beef of the fifteenth and sixteenth centuries were washed down with a tankard of ale. The oatmeal porridge of the North of England and Scotland, regions which certainly reared in the olden time a hardy and eupeptic population, was in itself a very moist food, and was accompanied by milk or buttermilk.

But milk itself no longer passes unchallenged. We are told that it may very possibly contain the germs of tubercular disease, and that, if it has been diluted with water from some well guilty of cesspool contamination, it may introduce typhoid fever into our families.

We go back to the dietary scale proposed by the medical man who recommends a vegetable breakfast. For dinner he allows "Plain meat, with bread and one vegetable. No dessert and no drink." For supper, "Bread and butter, with a little fruit." Elsewhere he writes:—"The vital question of food, of plain food, plainly cooked and eaten in moderate quantities, they dare not mention unless to ridicule it." And again:—"One of the great table errors is excess in quantity. And this comes in part from too great variety."

There is in these passages much that cannot be allowed to pass unchallenged. Experience has taught us to dislike the word "plain," and those who use it in a laudatory sense. A "plain man" is generally one who turns up his nose at truth and beauty, and thinks that all human duty is summed up in money-getting. "Plain cookery" we have always found to consist essentially in taking good materials and converting them into at once the most costly, the most indigestible, and the most unsavoury dishes.

"Excess in quantity" cannot in these days be a general table error. If we look at the rates of wages and salaries, and even of profits in the smaller businesses, and compare them with the current prices of the most necessary articles of food, we shall see that for the many the sin of gluttony is rendered physically impossible. In England, at least, we must strangle—metaphorically at least—the hordes of salesmen, middlemen, and rings which have forced themselves in between the producer and the consumer, before the workman, the clerk, the small tradesman, and the less prosperous professional man will be in serious danger of over-feeding. And is excess in quantity likely to spring from variety? Surely not. Savoury food, not affected with "plainness," is eaten slowly and thoroughly masticated, so as to enjoy its flavour, and is thus thoroughly insalivated and readily digested. "Plain," monotonous food is bolted in lumps, by way of despatching an uninteresting business. The unfortunate eater, as in the case of cold meat, is apt to "cut and come again" in the vain hope of meeting with some approach to a flavour. Or possibly he flies to pungent irritating condiments, salt in unreasonable excess, pepper and mustard, and red-hot pickles. An unnatural thirst is thus created, which is allayed, if possible, by floods of stout and bitter. So, for a thorough dietetic reform, we must begin by proclaiming war against plainness and monotony, fiery condiments, and bolting,—all cardinal sins of the English *cuisine*, and of the habits which it has induced.

We have long ago heard it maintained that especially in a cold, moist climate, like that of Britain, thirst is so far an artificial appetite that a man does not require to drink if his food is properly selected. To some extent we can confirm this view from our own experience. But the meals at which drink was thus felt to be unnecessary were not built on the above-quoted lines of "plain meat, with bread and one vegetable," and included at least six kinds of vegetable matter, most of them very juicy.

But the dietetic innovators with whom we have so far had to deal, however much they may seek to abridge our repasts in quantity and variety, do not prescribe animal food. This undertaking is left for a body of men who are known as vegetarians, and whose experiments on a superficial examination seem to be based upon scientific truths. On closer and impartial investigation they are found, however, to be mainly fallacious.

We may survey these arguments as summed up in the "Science Monthly" by Dr. T. L. Nichols, who seems to us to expound rather than to advocate the vegetarian creed. He writes:—"If it were a question of economy of feeding, that would be easily settled. There is no doubt that *any given territory* will sustain from six to ten men on fruits, grains, and vegetables, to one on flesh. The oatmeal which, converted into pig, will feed one man, will give a purer and more sustaining diet to fourteen in its original condition. Dense populations must of necessity live mainly on the unchanged products of the vegetable kingdom. In tropical climates it has been found by experiment that an acre of land planted with the banana would feed twenty-five—Humboldt says thirty—persons. In England we think each mouth must have its acre."

The fallacy here lurks in the words which we have italicised—"any given territory." Take a plot of fruitful ground, in a genial climate, capable of being fairly drained, and liable neither to prolonged drought nor to capricious inundations, and the Vegetarian contention is true. Such land will doubtless support from six to ten times as many men if devoted to agriculture as it could if given up to grazing purposes. But unfortunately there is abundance of land which will grow grass, though it will not produce fruits, corn, or vegetables. Hence it can only be utilised as grazing ground, and under a Vegetarian *régime* it would have to be abandoned.

Such, in Britain, are the moorlands and mountain-pastures of Wales, Cumberland, and the North of England. The

shallowness of the soil, the difficulty of access, and the severity of climate consequent upon the height above the sea-level, render these tracts utterly incapable of cultivation. But for grazing purposes they are not without value. We may take, again, low-lying districts, marshes, and the like, liable to be overflown. No one cares to plant crops which he may lose by a sudden rising of the waters. But they are available for grazing, as cattle may be driven for safety to higher grounds in case of a flood. Or let us take the celebrated Vale of Aylesbury, with its rich, deep soil,—unfortunately, from the scanty slope of the soil, difficult to drain. Here you may march for mile after mile and see nothing but grass ; grass, everlasting, monotonous grass. The natives will tell you that crops do not pay as well as grazing. Indeed, since the present fit of cold, wet summers set in, landowners and farmers, England over, are being advised to convert their available lands into permanent pasture.

In warmer and drier climates, such as the Cape, Australia, &c., the possibility of severe and prolonged drought discourages farming, properly so called, and encourages sheep-breeding. Thus the world over we shall find, on taking a fair average, that if we should by adopting the Vegetarian system gain on one acre of land, we should lose on another.

But there is another item in the account which Vegetarians overlook. So long as man consumes a mixed *régime* he derives no trifling part of his sustenance from the sea, and this portion it is generally considered is capable of indefinite increase. Are we to sacrifice the Fisheries in deference to Vegetarian scruples? If so, the question of "economy of feeding" will soon be settled, though in a different way, from what dietetic reformers fancy.

Elsewhere we read—"Vegetarians point to the striking fact that the animals most nearly resembling man, anatomically and physiologically, and to which he is supposed to be most nearly related by descent, live on fruits and other vegetable substances. Anatomists and naturalists declare that man is frugivorous. Primitive man is supposed to have lived on fruits and nuts."

Here also is a strong admixture of error. The monkey tribe undoubtedly form the closest approach to man, both morphologically and physiologically. But along with fruits they feed upon insects, eggs, and probably small birds.

Modern anatomists and naturalists know that the habits of an animal cannot always be deduced with unerring accuracy from its structure. How close, *e.g.*, is the resemblance

between the digestive organs of the rabbit and of the rat. Yet the rabbit is, as far as we know, purely phytophagous, whilst the rat is partly carnivorous, and attacks or kills other animals to obtain animal food.

How man first adopted a mixed diet is of course a difficult question. Perhaps the anthropoids from whom he has descended had already taken this step. It is, however, well to remember, as several travellers have pointed out, that cannibalism is generally to be found where animal food is wanting.

We are told that "Eminent authorities like Sir Henry Thompson, Dr. Richardson, Mr. Buckmaster [*sic*], &c., have asserted the sufficiency, the purity, the healthfulness of a vegetarian diet; the only question is whether there may not be some benefit in an admixture of animal matter,—a moderate proportion of flesh, fish, milk, butter, cheese, eggs. Even the so-called Vegetarians make use of eggs, and milk and its products, thus drawing a portion of their sustenance from the animal kingdom. Their excuse for this apparent inconsistency is that milk is not flesh, but simply vegetable —elements gathered and stored for the calf until it can gather its own; while the egg, with the exception of microscopic germs, is not animal but vegetable matter, mostly albumen, stored up to feed the future chick."

We have often been struck with the inconsistency—not apparent, but very real—of the Vegetarians in making use of milk and eggs; but never before have we met with this excuse,—a plea which for effrontery is unmatched in the annals of controversy, and which it is difficult to pronounce other than dishonest. How the secretions of animals can be simply vegetable must be incomprehensible, unless animal and vegetable are synonymous terms, in which case of course the Vegetarian question falls to the ground as devoid of meaning. The idea of "vegetable matter" being stored up to feed the future chick will appear very strange if we reflect that the newly-hatched young of most birds, even such as in their adult state are purely frugivorous, are fed upon an animal regimen!

The dietetic reformers promise man length of days. Would it not be wiser if they strove to amend the quality rather than the quantity of life? We would also beg them to consider whether the dyspepsia, nervousness, &c., which they seek to combat by "severely plain living" are not mainly due to overwork under the pressure of anxiety?

IV. THE CRISIS AT THE BRITISH MUSEUM.

By R. M. N.

FEW naturalists, I apprehend, can now traverse Great Russell Street without a sigh and the exclamation "*Fuimus Troes.*" For them the British Museum is in one sense a thing merely of the past. Perhaps now the revolution has been consummated, and now there is little hope of its reversal in the lifetime of this generation, I may be permitted to attempt a brief and impartial survey of what the public has gained or lost by the recent changes.

Every reader of the "Journal of Science" will doubtless know that the British Museum has been, from its very outset, of a heterogeneous nature. Though under the control of one and the same governing body, it consisted in reality of three distinct institutions, very unequally yoked together, and not too amicable among each other. There is, first, the great National Library; secondly, the Collections of Antiquities and Works of Ancient Art; and lastly, though in my opinion of infinitely highest importance, the Natural-History Collections.

Between these three departments there has always been a rivalry for working funds, and latterly for room. In both these respects the Natural-History Department generally came off worst. Scientific men have often had to feel disgusted at seeing money lavished on ancient manuscripts whilst important palæontological specimens were secured by private collectors or by rival establishments abroad. On this point I need, however, say the less, as I am not aware that the recent changes extend to the appropriation of funds.

There remains the great question of space. The growing extent of all the collections demanded more room than could possibly be provided in Great Russell Street. One of the departments must therefore be removed, and unfortunately, and as I hold most injudiciously, the lot of banishment fell upon the Natural-History Department. The removal of the Library, indeed, to some remote suburb would have been nothing short of a national calamity, and I can only hope that such a step may never be seriously proposed; but the transportation of the Antiquarian Department to South Kensington would have been more rational than that of the

Natural-History collections. The Elgin marbles, &c., being almost exclusively examined by students of the Fine Arts, would have there been in place. In short, the South Kensington Museum being devoted to objects of the Arts, a further collection of the same nature would have been "like to like." Why should the art-student be compelled to make a pilgrimage to Great Russell Street, instead of finding in some one spot—be it South Kensington or elsewhere—all the objects he might wish to study concentrated for ever? I hold, in short, that all the Art collections, now scattered abroad, should be assembled in one locality, even if their different arrangements should prevent them from being united in one grand Art Museum, a London Louvre. Had this been done the Natural-History collections might have found ample space in Great Russell Street for many years to come.

Again, even supposing that these collections should ever require removal, surely a more suitable locality might have been found than the one to which they have been consigned. The arguments to this effect are so exceedingly plain and cogent, and have been so often put forward, that I should feel ashamed of once more repeating them save for the circumstance that they have never been met, save with the "conspiracy of silence." Surely all persons possessing the least residue of common sense will grant that the first essential for the site of any public office or institution is centrality, or the nearest practicable approach thereto. It must further be admitted that the need for such centrality is more pressing in a large city than in a small one, and in London strongest of all. If this condition is overlooked the inhabitants of some one district are favoured at the cost of the majority. This principle is admitted and acted upon as regards public buildings for other purposes. When, *e.g.*, it became desirable to provide better accommodation for the courts of justice, and to collect them together in one spot, no such considerations as cheapness of land, abundance of space, and scope for architectural display were entertained as arguments for removing the law-courts from Westminster to some remote suburb. Had the suggestion been made it would doubtless have been dismissed as not worthy of a serious consideration. Why, then, should the case be different as regards a Scientific Institution?

It may, indeed, be said that by means of the District or the Metropolitan Railways we may be carried from many parts of London, and put down—in the absence of explosions—at a spot very near the new Natural-History Museum.

But a majority of people do not live near these railways, and have in consequence first to take a journey by omnibus, tram-car, or by some other railway, losing more or less time at each change. I have calculated to what extent I am the loser by the alterations in question. Admitting that Great Russell Street is not the most central locality conceivable, and premising that I do not live very near the old Museum, I was able to reach it in less than an hour; but after trying and comparing various possible routes, I find that it takes me an hour and a half to reach the new Museum. Thus on the double journey there is the clear loss of an hour, taken, be it well remembered, out of the best part of the day. Nor is my case at all singular; I have compared notes with others who, like myself, are interested in the study of Natural History, and I find that they all experience a loss of time, greater or smaller, according to the spot where they happen to live.

There is here a further and a no less important consideration: the new Museum stands quite isolated. Whoever wishes to visit it must undertake a special journey for that purpose; he cannot intercalate it among a round of other places where he has to call. Now with the old Museum this was not so; a man wishing, *e.g.*, to compare some specimen which he had received with the nearest approaching forms known could call there in passing, without the formality of a special journey.

It must also be remembered that South Kensington is a "locality" for the wealthy only. Students and men more advanced in life, who devote themselves to the commercially barren task of scientific research, can scarcely be expected to take up their abode in so expensive a quarter. Even if they did so they would thereby be deprived of convenient access to the British Museum Library and to other means of study. This separation of the Library from the Collections is in many cases inconvenient, both for the public and the officials. It is beginning to be found that a special library of Natural History will be needed for the use of the latter, —of course at considerable cost and not without difficulty, since many of the most important works of reference are out of print.

What may be the motives which, in the face of these considerations, moved the powers that be to this great revolution I have never been able to learn. I find the step referred to with approval by the organs of official Science and in certain published speeches; but could the question of removal to South Kensington have been submitted to a *plebiscite* of

Naturalists, it would, I am sure, have been negatived by a large majority.

There is an innovation, not peculiar to the British Museum, to which I cannot help referring,—the introduction of "refreshment rooms." This feature seems to me, to say the least, utterly needless. Few persons remain in a museum longer than four or five hours at a time, and I am heartily sorry for those persons who require food and drink at shorter intervals. This matter is intimately linked with one of the unsettled questions of the day—the opening of museums, galleries of art, public libraries, &c., on Sundays. I am by no means certain that such opening is demanded by any large portion of the public, or that it would be productive of good if carried out. But by connecting museums with refreshment rooms the advocates of Sunday opening should reflect that they enlist against themselves the sympathies of that large, well-organised, and earnest body who now demand the total suppression of the liquor traffic on Sundays.

Furthermore, it may well be asked whether it is wise in places devoted to study to supply the means for alcoholic excitement and for possible disorder. The refreshment room will attract not students, but loungers, and induce them to stay longer than they otherwise would, and to appear in their least desirable aspect.

V. THE IMPORTANCE OF INSECT-CAPTURE FOR DROSERA ROTUNDIFOLIA.

By H. M. Busgen.

THE existence of so-called carnivorous plants, fitted with special but varied appliances for capturing flies and other small insects, is now no longer disputed. The more closely the vegetable world is studied from this point of view, the more of such fly-catching species are discovered. A recent instance is the common Petunia, so long a favourite in our gardens. Numbers of florists and others must have noticed little gnats, &c., sticking fast among the minute hairs on its leaves. But till lately this fact was

considered a mere accident, of no importance in the economy of the plant. Whether our zoophilists will on this account banish the Petunia from their gardens it remains to be seen.

Nor is the mere capture of insects by plants the only point thus recognised. It is fully established that the little prisoners are made to undergo a kind of digestive process. Their bodies, whilst adhering to the flowers or leaves of their captors, are liquefied, and appear in that state to be absorbed into the tissues of the plants.

But a third question has been left to some extent open. Do the insects thus caught promote in any way the well-being of a carnivorous plant? Would it flourish as well—or perhaps better—without insects, or any equivalent animal matter, as with them? On this important point botanists of eminence are by no means at one. Comparative experiments made upon the influence of a supply of white of egg have given fluctuating results. Some of the observers have found the plants thus fed decidedly benefitted as compared with other specimens from which such diet was withheld. Other experimentalists have been unable to perceive any difference; and others, again, have even reported injury,—the plants being apparently the worse for the absorption of animal matter.

Results so diametrically opposite can be explained only on the assumption that the initial conditions of the plants selected for experiment must have been dissimilar. Further investigations were therefore needful, in which all sources of error should be eliminated. H. Busgen has endeavoured to secure a perfect uniformity by beginning his observations with the germination of the seed.

The experiments were made upon the Sun-dew (*Drosera rotundifolia*), and the results are more immediately applicable to this species alone. The seeds of this plant are so light that a hundred weigh only 2 milligrammes, and a single seed only 0·02 milligramme. Differences in the dry weight of single seeds could therefore be safely neglected, and the weight of the dry seed obtained at the end of the experiment from the fed and the unfed plants respectively could be taken as an accurate expression of the results.

Ripe seeds of the Sun-dew were therefore collected at the end of October, 1880, and were kept in a cellar through the winter. Part of them were sown at the end of January, in a glass case, upon a piece of peat which had been previously boiled in water. In May the seeds germinated, and by June 22nd there were so many plants of equal size that

the feeding could be commenced. A loose piece of peat was cut smoothly in two, parallel to its longest surfaces, and boiled for half-an-hour in a culture-solution at 2 per 1000 (50 parts potassium nitrate, 20 of calcium sulphate, 10 of magnesium sulphate, and 5 parts of sodium chloride). When cold, eighteen young plants which had just put forth their first leaves were set upon each of the pieces of peat in three rows. The peats were laid upon plates filled almost up to the upper edges with the same solution, fitted with gauze covers, and placed in a window with a south-east exposure. On June 22nd and 28th, July 1st, 6th, 12th, and 22nd, in the beginning and the middle of August, and in the middle of September, all the leaves of the one series which showed a sufficient secretion were supplied with larger or smaller Aphides, corresponding to their size. Every day the plates were filled up with distilled water to make up for the loss of evaporation, and from time to time the plants were carefully freed from Algæ.

On July 22nd, four weeks after the commencement of feeding, the eighteen plants which had been fed had ninety leaves, and the eighteen which had not been fed ninety-five. The greater number of leaves of the unfed plants showed that those selected for this series were in the beginning the more advanced. But as regards the strength of the plants and the size of the leaves the fed plants had already the advantage.

At the end of October the leaves faded. The plants were placed in a cold frame, looked over every fortnight, and supplied with water as it was needful. At the end of April they were cleaned. On May 5th, when feeding was recommenced, fifteen fed plants had together 126 leaves, and sixteen unfed plants 96 leaves. All the fed plants showed a vigorous growth; of the unfed ones two only appeared equally strong. The remainder were partly about half as strong, or still feebler. Still all were apparently healthy, and their glands secreted in the normal manner.

Corresponding to the increased strength of the plants and the larger diameter of their leaves, each leaf of the "fed" series was now supplied on the average twice weekly with a larger number of Aphides. The time of feeding was regulated according to the weather, selecting such as seemed favourable to the capture of insects and to the secretion of the glands.

During the summer blossom-heads appeared upon both series, and by July 26th the seed-capsules were ready to be gathered. The following figures will show the results:—

14 fed plants yielded 17 heads of blossom, whilst 16 unfed plants produced 7. The 14 fed plants had 90 seed-capsules, the 16 unfed plants only 20. An enumeration of the leaves could in this stage be no longer of importance, but a superficial census showed on 14 fed plants 194, and on 16 unfed plants 222.

Of the thirty-six plants with which the experiment was begun there died altogether six, four fed and two unfed. If we are unwilling to ascribe this proportion to accident, it still does not affect the result. If, in nature, the number of the plants which die yearly is increased by the consumption of insect prey, this loss is covered by the more luxuriant fructification of the survivors.

The last doubts as to the benefits of feeding in the case of *Drosera rotundifolia* were removed by a determination of the total weight of the plants when dried. The figures were:—For the fed plants 0·352 grm., for the unfed ones 0·110. The solid matter absorbed by the latter in the course of their development amounted therefore only to 33·8 per cent of that assimilated in the same length of time with the aid of animal food.

Herr Busgen has carried out several other series of comparative experiments in which the conditions of nutrition were less favourable. Thus to one series of plants there was given, instead of the culture-solution, spring water and distilled water: in the second series there was used a liquid containing potassium chloride in place of potassium nitrate; the results were, however, similar to those already given.

In a communication to the "Botanische Zeitung" Herr Busgen summarises the results of his investigations as follows:—We must regard it as demonstrated that the organism of *Drosera rotundifolia* is supplied through its leaves with animal matter which is of great importance for the development of the plant, and especially for its fructification. The necessity of this method of nutrition for the preservation of the species could only be proved by the cultivation of several successive generations. Its demonstration would, however, present little especial interest. The demonstrated advantage of the fed plants as compared with those not fed is sufficiently striking to make the arrangements for this purpose intelligible.

There can be little doubt that similar results would be obtained on careful experimentation with other insectivorous plants.

VI. FLORIDA.

By W. D. GUNNING.

ON Palm Sunday (*Pasqua Florida*) of the year 1512 Ponce de Leon discovered the peninsula which forms the eastern boundary of the Mexican Gulf, and named it after the day *Florida*. For many years the name covered what are now the Carolinas, North and South, and a portion of Georgia, Mississippi, and Louisiana.

Florida is the youngest portion of North America. It lies along the trend of the Appalachian Mountains, whose axis is the archæan granite. A few months ago, in boring an artesian well at Gainsville, this same granite was struck. We may assume that it underlies the whole peninsula, and is the foundation on which the coralline structure was built. Florida is a succession of coral reefs. Geologically it is young, as all the fossils are of living species.

As the peninsula nowhere rises more than 250 feet above the sea, its features are simple and monotonous. The rivers could not sculpture the face of the land into valleys or canyons. The bane of the high table-land on our Pacific slope is over-drainage; the bane of Florida is *under-drainage*. The Colorado dashes wildly through a gorge of its own cutting, 5000 feet deep. The Saint John flows sluggishly in a channel barely deep enough to carry its face below the bounding marsh or "scrub," or pine-land. A result of this under-drainage is an immense acreage of swamp-land.

While in the geologic calendar Florida bears the date of yesterday, its flora and fauna are ancient. The *Tapodium*, known as the Bald Cypress, is the largest tree on our Atlantic slope. A fact of deep interest is that this cypress stands in close relationship to the *Sequoia* of California and *Glyptostrobus* of Japan. The *Sequoia gigantea* is restricted to a few isolated patches in the Sierras. The *Tapodium distichum* grows on the swamps and on the low river-banks of our Southern Atlantic States. *Glyptostrobus*, *Sequoia*, and *Tapodium* have descended from a common stock. Their geographical distribution is evidence of great antiquity. Their divergence in botanical structure and habitat—*Sequoia* adapting itself to an altitude of 6000 feet, and *Tapodium* to marshes at the sea-level—is evidence that the dispersion occurred long ago.

Another tree of historic interest is the *Torreya*. Only four species are found; one in China, one in Japan, one in California, and one in Florida. The *Torreya Californica* is rare in California. We have found it only in the Yosemite, although it occurs in other parts of the State. The *Torreya taxifolia* is restricted in Florida to a district not more than 10 miles long, on the banks of the Apalachicola. This ancient genus is moribund.

On the "Keys" the flora is tropical. The Keys are coral reefs just emerging from the Atlantic. Those which are least advanced support no growth but the mangrove. The seed is borne on the tide from adjacent land, and its mode of growth is such as to give the tree anchorage to the coral. On the low Keys, called the Thousand Islands, the mangrove attains a height of 60 feet.

The mahogany has held a place in the list of Floridian flora, but it grows only on Umbrella Keys.

Gummifera might be written as the specific name of many shrubs and trees of Florida. *Bursera gummifera*, called "gumbo limbo," is most prolific in gum. The *Ficus aurea*, or wild fig, exudes a gum something like india-rubber.

The Sive oak is abundant, but is often dwarfed. The red cedar attains its highest excellence on Cedar Keys, where it is cut for the pencil-factories of the north. It is the *Bermudiana*, a variety of the *Juniperus Virginiana*.

The pitch and yellow pines occur everywhere except in the swamps. The *Sabal palmetto* is anywhere except on the high pine-land.

A peculiarity of all Florida trees growing in wet or boggy land is a bulging out of the trunk near the ground. It is most striking in the bald cypress, and least noticeable in the oaks.

The herbaceous flora is rich and varied. I have seen the face of the earth saffron-coloured from a carpet of *Polygala nana*. I have seen a roadside fringed with that beautiful orchid *Pogonia*. Perhaps the most highly specialised plant in the State is the *Sarracenia variolaria*, introduced to the botanical world a few years ago by Dr. Mellichamp, of North Carolina. It is carnivorous, and as a fly-catcher it is excelled only by its cousin, the *Darlingtonia* of California.

The fauna in mammalian types is poor; in reptiles, birds, and insects it is rich. The alligator is common, and the true crococile has been found, although it is rare.

When Florida came under the eye of history she supported a tribe of Indians, the Seminoles, who had made a little advance in agriculture. A remnant of this tribe still

lingers on the skirts of the everglades. The Seminole knows nothing of the shell-heaps which abound on the banks of rivers and shores of the sea. They are memorials of an older race. In the oldest shell-mounds no pottery is found. Only a few implements have been discovered, and these were wrought of shell and bone. Bones of animals killed for food are rare. The people who made these mounds had not learned the arts of agriculture. They lived almost exclusively on mollusks and fishes. Florida sustained her primitive man on an exquisite climate and the product of her waters.

Ponce de Leon and his men brought with them oranges from Seville. The seed dropped on the Spanish camps found a better climate than they had left. Orange groves sprang up in the footprints of the Spaniard. In the absence of cultivation the trees lapsed. Perhaps no neglected fruit reverts to a state of nature more rapidly than the orange. Now and then it lapses into a primitive state. The orange is a berry with a leathery rind. Farthest from the berry is the achene. This is a small, dry, indehiscent fruit; its typical form may be seen in the buttercup, which, in structure and colour, is a primitive flower. Now the orange is occasionally found to lapse toward this early, apocarpous condition; the segments partially separate, and a leathery rind encloses each segment.

The Spaniards made but little out of Florida. The English, who followed, made no more. They ceded the peninsula back to Spain, and in 1820 Spain ceded it to the United States. We fought the Seminoles, cultivated a little cotton and cane, and raised cattle of little worth on worthless grass. In our civil war attention was directed to the orange. In antebellum times, only here and there, a man more enterprising than his neighbour had cultivated this fruit. The only variety known was the Florida seedling. It is a choice orange, but it is only the old Seville modified by climate and culture.

The State is gaining rapidly in population and wealth. Orange growing has become a great industry. The promised gains have lured Swedes in colonies, and English and French and Germans in individuals.

These words may fall under eyes bent on Florida, and to be helpful we must be specific:—

First.—Only a small portion of Florida is fit for the growth of oranges. Choose the richest soil you can find, and be sure it has a clay sub-soil. You will find no *rich* soil in the State, unless it be under water.

Second.—Bear in mind that oranges are coming under the law of other fruits, and will be sold as *varieties*.

Third.—You may reasonably infer that if the environment in Florida has improved the Seville, it may improve other and choicer varieties. Experiments are confirmatory. The best oranges grown in Europe are the Jaffa, the Malta oval, the Majorca, and the Mediterranean sweet. Each of these varieties, when grown in Florida, has improved in flavour or other qualities. The Jaffa, as grown in Jaffa, does not keep. It deteriorates before it reaches London. Grown in Florida it can be taken in the best condition to the northern markets or to London.

Fourth.—In the light of these facts you will select for your grove the best sports from the Florida, as the Magnum-bonum and Homasasa, a few Mandarines, and the best varieties from Europe. Select your trees carefully, fertilise judiciously, cultivate every spring and summer month, and in five years you will have an income. When your trees are in full bearing you will have from 500 to 1000 dollars an acre.

If you have located well to the south, cultivate the lemon. Villa Franca is the best variety. Pineapples may be grown as profitably as either oranges or lemons.

Do not heed the cry of over-production. In 1850 the value of fruits grown in the United States was 7,723,600 dollars; in 1880 the value was 50,873,150 dollars. In these figures we make no account of what was consumed by the grower. Our population within thirty years has increased threefold; the consumption of fruit has increased sevenfold.

It is a great misfortune that the Spaniards who dropped the seeds of their orange did not drop a few seeds of their Cuba grass (*Panicum jumentorum*), or the Sorgum grass (*Sorgum halapense*). "Man cannot live on bread alone," neither on oranges. Flocks must give him of their milk and feed him of their flesh; herds must have pasturage. The crying need of Florida is *grass;* her native grasses, *Chloris floridana* and *glauca*, *Panicum fuscum* and *striatum*, and a few species of *Paspulum*,—all known under the general name of Wire-grass,—are of little worth. Both Cuba grass and Johnson grass, if generally introduced, would give the Floridians good milk and palatable beef.

Health they have, and a climate superior to any other in the western world. Florida is on the border of the torrid zone; she lies within lines of latitude which would give her rank as one of the hottest portions of the globe; but she is

a *peninsula*, and is swept alternately by winds from the Atlantic and winds from the Mexican Gulf: heats which would otherwise scorch her are mitigated. In summer the thermometer never rises as high as in the Northern States, and in winter it seldom sinks to 40° F. The characteristic is mildness and uniformity.

Winter life amid the balsamic odour of the pines is simply delightful. The skies are of softer blue than those of Italy. Birds of rarest plumage seek the lakelets, and a bird of many songs mocks from pine and orange, and even the trellis of your verandah every throat that warbles; and Florida seems an eternal *Pasqua* Florida—a Palm Sunday.

Washington, D.C., U.S., October 20, 1883.

VII. SENSIBILITY TO LIGHT AND COLOUR IN EYELESS AND BLIND ANIMALS.

ACCORDING to the present state of our knowledge it is beyond doubt that light, *as such*,—*i.e.*, unaccompanied by radiant heat, has an effect upon animals not merely by means of the organs specifically developed for its perception. It produces physiological changes of greater or less intensity in its passage through the skin, or through the body in general. For a closer investigation of this latter action of light—the "photodermatic"—experimental investigation has not been confined to eyeless species, but parallel researches have been made with blind animals. Hitherto most of the experiments upon the action of light upon eyeless and blind animals have been confined to the influence of rays of different colours and intensities upon the development of the animals in question. Prof. V. Graber, however (in the "Sitzungsberichte der Wiener Akademie" for 1883, p. 201), has raised the question whether, and to what degree, eyeless and blind animals are sensitive to differences of light, and manifest this sensitiveness by moving towards or away from the light.

The number of the animals thus tested was as small as possible. The experiments were confined to one representative of the normally eyeless groups,—namely, the earth-worm,—and to one representative of a blind animal, for which purpose the common water-"newt" (*Triton cristatus*) was selected.

As regards the eyeless animals, the experiments, of which the author gives a brief abstract, are not of such a nature as to render further exact investigations needless. For his experiments on earth-worms he used a box consisting of perfectly equal and similar compartments or cells. The front and back of the box consisted of panes of quite clear glass, puttied water-tight in the framework. The latter was further provided with grooves for the occasional introduction of panes of glass and bottles with parallel sides. The cells had each a separate cover, and could be separated from each other by perpendicular slides. By introducing two slides the box could be divided into three compartments, each of which had two front and two back windows. The latter, however, were covered, so that the light was admitted merely from the front. The bottom of each cell was covered with mud, but in so thin a layer that the worms could not hide themselves in it. For obtaining different degrees of light the two windows were used, one being uncovered and the other darkened by the introduction of a slip of wood, or both were fitted with media of different colours.

The experiments were conducted in the following very simple manner:—At the beginning of each experiment a considerable number of worms (20 to 30), just dug up, were placed in each compartment, and were distributed as equally as possible over the entire surface. The box was placed at a window having a northerly aspect, and at regular intervals—in general every hour—the number of specimens in each of the differently lighted cells of each compartment was taken. The worms were then again equally distributed, and at the same time the position of the light-absorbing media was changed. From time to time, generally every four hours, the worms were removed, and fresh ones were substituted.

The first experiment consisted in leaving these animals the choice between a relatively light and a comparatively very dark compartment. In seven enumerations there were found in the light compartment 40 worms, and in the dark one 210. The proportion of these two numbers, the "quotient of reaction," is therefore 5·2. It may be asserted without any doubt that a strong light is very unpleasant to

worms. But these animals react not merely with such great differences as existed in the above experiment, but with very slight distinctions. If the experiment was so modified that the one window was of clear glass and the other of milky glass, there were found in the light compartment 204, but in the darker one 326, or a majority of 122. Though this difference is not very great, Prof. Graber considers it allowable to infer that earth-worms are capable of recognising the difference, and would even be able to react upon far smaller variations in the intensity of the light.

In the following experiments on the sensitiveness of earth-worms to qualitative differences of illumination the coloured lights employed were selected of equal intensity, in order to eliminate the influence of different intensity which has been shown above. As this is difficult to carry out in practice, the experiment was so arranged that in each pair of colours first the one and then the other was selected much the lighter. After it had been proved that the earth-worms were attracted by red, but repelled by blue, in all subsequent experiments the blue was chosen much darker than the red. In twelve enumerations there were found in the light red 193, and in the dark blue only 57 worms, so that the red blue quotient = 3·4. If we consider that, as far as the intensity of light is concerned, the worms would give the blue compartment the preference, it is fully proved by these experiments that these animals are exceedingly sensitive to qualitative differences of light.

A comparison was next instituted between ordinary white light and white light from which the ultra-violet rays had been eliminated by a passage through carbon disulphide. In five enumerations there were found in the white free from ultra-violet 87 worms, but in the ordinary white light only 13, the quotient therefore being 6·6. Worms, therefore, seem to have a strong dislike for the ultra-violet rays.

A comparison between light green and dark blue gave in the former 138, as against 42 in the latter, the quotient being = 3·3.

Finally, experiments with light red and dark green gave the respective numbers 168 and 72, or a quotient of 2·3.

We cannot help pointing out how fully these results disagree with the common notion of the beneficial effects of the blue light both upon animal and vegetable life. Our readers will doubtless remember a work written by General Pleasanton, in which the author recommends blue light as a means of promoting the health and vigour of both animals and plants, and even of curing certain diseases. M. Yung,

after a series of experiments upon various ova and larvæ, found the action of the colours favourable in the following order: violet, blue, red, yellow, white, and green, the red and green rays being positively hurtful. We must confess that this summary of results obtained by M. Yung, and published in the "Comptes Rendus" of the French Academy of Sciences, seems to us deficient in intelligibility. If the red ray is "positively hurtful," and if yellow and white lights are still less favourable to animal life it must, we think, naturally follow that they are hurtful also. It would therefore seem that further research in this direction is imperatively demanded.

The great sensitiveness of earth-worms both to different intensities and colours of light having been thus demonstrated, Prof. Graber undertook further experiments to test whether the entire skin of the worm is sensitive to light, or, as certain earlier observers have concluded, the anterior portion only. To this end similar series of experiments were undertaken with worms from which the anterior portion of the body had been removed. These experiments gave for light and darkness the quotient 2·6, and for red and blue 2·8. These values are smaller than those obtained with entire worms, but they still permit us to conclude that the entire surface of these animals is sensitive to quantitative and qualitative differences of light.

In view of the sensitiveness of the skin of eyeless animals it became desirable to ascertain the behaviour of the skin of blind animals towards light. For this purpose the sensitiveness of the salamander (it is here doubtful whether Prof. Graber refers to *Salamandra maculata*, or, as would seem from an earlier passage, to *Triton cristatus*) to differences of light was examined, both in its normal state and when blind. Normal salamanders gave in eight enumerations, for the light compartment 1, for the dark 159. With blind salamanders there appeared in eighteen enumerations, in the light cell 135, and in the dark 308. Hence it is legitimately inferred that these animals, even without their eyes, are aware of great differences in the intensity of light.

As regards qualitative differences of light, blind salamanders are also found to be sensitive. The behaviour of the normal salamander was first tested with light red and dark blue light. In ten enumerations there were found 192 in the former, and in the latter 8, the quotient being = 24. With blind salamanders Graber found 536 in the light red, and 406 in the dark blue, or a quotient of 1·3. It is therefore not doubtful that the blind salamander, as well as that

possessing normal vision, distinguishes between red and blue, giving the former the preference. When both colours were approximately equal in intensity there were found in the red 474, and in the blue 176, the quotient therefore being = 2·7.

Three further series of experiments were made upon blind salamanders to test their behaviour in white light respectively containing and deprived of the ultra-violet rays. In light which was relatively bright, but free from the ultra-violet rays, there were found 313; in unaltered, but relatively dim light, there were 149, the quotient being = 2·1. A comparison of the two colours green and blue gave, with normal specimens, in the green 299, in the blue 98, or a quotient = 3·1. With blind specimens there were found, in the green 131, in the blue 79, the quotient being = 1·6. For red-green, with blind animals, the quotient was = 1·8, and for red-yellow = 1·4.

It is therefore proved, in the most decided manner, that blind animals are sensitive to quantitative and qualitative differences of light. The signification of this fact may be manifold. The first possibility, that effects of heat are concerned, is excluded by the experiment in which the salamanders were found thermophobic, so that they should shun the red light and seek the blue, whilst the contrary is the case.

Of the two other possibilities, that differences of light are recognised either by their chemical action or by a direct influence upon the sensation of the skin, Prof. Graber decides in favour of the latter, and for the following reason:—Let us suppose the entire sensibility of animals for light were what the theory of Descent demands or seems to demand, —*i.e.*, that the eyes are, indeed, the main organs for the perception of light, but that the skin still takes a certain share therein, since prior to the differentiation of the eyes it was the sole organ for light. Let us then ask what would be, on this supposition, the reactions of normal and of blind salamanders. Two results may naturally be expected:—First, in the blind, and therefore exclusively dermatoptic, animals there would be the same preference for certain kinds of light as in the ophthalmoptic normal individuals. Secondly, the reactions of the former must be decidedly slighter than those of the latter. According to the experiments above described both of these results follow.

It will at once strike the reader that the experiments of Professor Graber have been confined to animals which are lucifugous, light-shunning. With animals which are diurnal,

light-loving, it is very possible—indeed probable—that these preferences for colours will be of a very different kind, perhaps even reversed.

VIII. CANINE INTELLIGENCE.

I.

"TO Newton and to Newton's dog Diamond, what a different pair of Universes; while the painting in the optical retina of both was, most likely, the same." So writes Mr. Carlyle in the First Book of his "French Revolution." Different indeed; if we can be permitted without extravagance to speak of the Universe as existing at all for Diamond, or allowed, except in hyperbole, to set side by side a conception of ultimate generality, like the Universe, the summation of all conceptions, and "the painting on the optical retina." Mr. Carlyle's meaning is, however, clear, and his thought profound. Given two different minds, and the same facts: how different are the products! In the thought called up by the sight of the simplest object we give far more than we receive; and what we give is a special resultant of inheritance and individual acquisition. No two of us give the same in amount or in quality. It is not too much to say that for no two human beings is the world we live in quite the same.

And if for no two human beings is the world we live in quite the same, how different must be the world of man from the world of the dog,—the world of Newton from the world of Diamond. It is difficult enough for us to put ourselves in the place of children, of farm labourers, of savages, —to think ourselves into their modes of thought. Difficult or impossible. And yet the *ratio of the senses*, if I may use the expression, is the same, or much the same, for savage and civilised. For both, sight and touch are the dominant senses; hearing, smell, and taste being subsidiary. But in the dog the ratio is by no means the same. Not sight and touch, but sight and smell are the dominant senses. And so great a difference must this alone make that we can but

guess what the world of the dog is like. Both in the nature and amount of its *thought*, and in the nature and amount of its *feeling*,—both in its perceptions and in its emotions,—is the canine mind a mystery to us.

But have we any warrant for speaking of thought or of feeling as even existing for the dog? Can we properly speak of a canine mind at all? In their answer to this question untutored Common Sense and the Philosophy of Evolution are at one. It may be a mind of which we know, and from the nature of the case can know, very little; but that there is a brute consciousness clown and naturalist agree. We only know of its existence by inference it is true. Consciousness cannot act on consciousness except by means that are indirect. Mind can never come into direct contact with mind. But that our brothers and sisters have minds like our own, and that Carlo and Pincher have a consciousness that foreshadows our own, is a belief that emerges in childhood, and one that can be justified at a period of maturer thought. The doctrine that animals are automata does not touch this question, for none of the arguments on which that view is based deal at all with the question of consciousness. If they be automata, there is nothing to show that they are not conscious automata. From the nature of their actions we are impelled to believe that, automata or non-automata, they are conscious. And the doctrine of Evolution has furnished a firm basis for that belief. Reject that doctrine, and this firm basis is destroyed. You are ready, with Prof. Max Müller, "to say again and again that, according to the strict rules of positive Philosophy, we have no right to assert or deny anything with reference to the so-called Mind of animals." There are many, however, who regard this belief in animal consciousness as a legitimate scientific conclusion based on the doctrine of Evolution. As such I for one am content to accept it.

Accepting, however, this belief in animal consciousness, we must still remember that both as a *product* and as a *process* animal thought can only be dimly guessed at. As a product we are unable to form any adequate conception of the picture of his surroundings that exists in Carlo's mind. Nor can we by observation learn anything very definite of Carlo's thought as a process. We are forced to judge entirely by inference from observed actions. Even with human beings this is not always by any means a safe process. Still more unsafe is it in dealing with the lower animals.

Are we, then, to leave this subject of Animal Intelligence or Canine Intelligence, to put it in a concrete form, on one

side as one in which Science cannot help us? Surely not. Surely we must make the best of the position in which we are inevitably placed. The theory of Evolution and Modern Constructive Psychology have lent to this subject an interest which it hitherto has lacked. They have shown that between Brute Intelligence and Human Intelligence there is organic connection. They have made Comparative Psychology, like Comparative Anatomy, a recognised branch of Science. Our interpretations may be—nay, must be—anthropomorphic; but to-day we are more than ever forced to attempt interpretations of some sort.

Let us now, by way of preface, ascend as rapidly as possible from the very lowest psychological strata.

All those simpler reflex processes which are connected with the continuance of life go on in the dog in much the same way as in man, and are probably as little conscious in the one case as in the other. These are, in fact, in ordinary language, rather vital processes than mental processes. They are, however, undoubtedly *neural* processes. And there are, I think, good grounds for regarding as mental all those processes which are effected by the nervous arc (afferent nerve, ganglion, efferent nerve). Indeed we *must* either do so or regard Mind as a shifting and disconnected phantasmagoria. A great number of reflexes, then, which are effected by the spinal cord, and the nerves connected with this chain of centres, go on in very much the same way in dog and man. So, too, do the still more important reflexes effected by the medulla oblongata. Throughout human and canine life alike this restless little knot of nerve centres is in ceaseless activity. The heart-pulses and the complex mechanism for effecting a variable supply of blood to the bodily organs, the regular sequence of breathing, the insensible perspiration of the skin, the play of the facial muscles, the co-ordinated movements of lips, tongue, palate, and throat which constitute the act of swallowing,—all these in dog and man are under the guidance of the medulla oblongata.

From these we may pass almost insensibly to those more complex reflex actions which are called *instincts*. It is, in fact, impossible to draw any hard and fast line between instincts and reflexes. The only assignable difference is in the complexity of the action. Hence Herbert Spencer's definition of instinct as compound reflex action. Take for example the so-called instinct of taking the breast. Both babe and pup, in common with all the higher Mammalia, come into the world with the suckling instinct in a condition

ready for immediate action. There is no learning to suck. And here we come upon a second definition of instinctive action as that which *need not be learnt*, which comes natural as we say. But to be a true instinct it must come natural not to the individual only, but to the species. The word *instinct*, however, is, like a good many others,—reason, sensation, perception, and the like,—extremely indefinite. In such cases the only thing to do is to note the want of definition, and to be on our guard against such confusion as is likely to arise therefrom. Instinctive action, then, in its broader sense is automatic action, action performed without any consciousness of choice. Instinct in the narrower sense is habit which through inheritance comes natural to a species.

The babe and the pup come into the world in such a helpless condition that this suckling instinct is perhaps the only one ready for immediate use, the only one possible to their connate mechanism. Some other creatures, however, make their first appearance with a far more developed connate mechanism. Everyone who has seen a litter of newly born piglings must have been struck by the lively and cheerful activity they at once display. When two or three minutes old they will find their way from one side of the sty to the other, making directly for their mother, guided by her helpful grunts. Mr. D. A. Spalding, by way of experiment, put a little pig in a bag the moment it was born, and kept it there in the dark until it was seven hours old. "I then placed it," he writes, "outside the sty, at a distance of ten feet from where the sow lay concealed inside the house. The pig soon recognised the low grunting of its mother, and went along outside the sty, struggling to get under or over the lower bar. At the end of five minutes it succeeded in forcing itself through, under the bar, at one of the few places where that was possible. No sooner in than it went without a pause into the pig-house to its mother, and was at once like the rest in its behaviour."

The hippopotamus seems to be quite as well off, on making his *debut* in the world, as his cousin. Thunberg, the South African traveller, relates, on the testimony of an experienced hunter, the case of a female hippopotamus who was shot the moment she had given birth to a son and heir. "The Hottentots," he says, "who imagined that after this they could catch the calf alive, immediately rushed out of their hiding-place to lay hold of it, but, though there were several of them, the new-born calf got away from them, and at once made the best of its way to the river."

To the question whether the performance of these in-

stinctive actions is accompanied by consciousness or not, no answer can be given, except the answer that we do not know. They may be conscious, they may not. They may, perhaps, be performed somewhat in the same manner as acts done under mesmeric influence. Merely to hazard a guess—though I think it is a guess that has foundations—I am disposed to think that automatic actions performed immediately after birth, at least in such imperfectly developed creatures as babies and puppies, are unconscious.

Besides those instinctive actions which can be performed at once and without practice immediately after birth, there are other instinctive actions which cannot be performed until the nervous and muscular mechanism is further developed, but which are then performed at once and without practice. Throw a new-born puppy into the river, and after some helpless floundering it will be drowned. Throw its brother, when fully grown, into the river, and, though he may never before have been in water, he will swim to shore. He has not to learn to swim. Swimming is with him an instinctive action. We cannot suppose that this instinctive action is also unconscious. At the same time it is probable that consciousness is occupied with a determination to get to shore, not with a determination to use these or those muscles in a particular way. The dog simply inherits the power which the boy must with some little difficulty acquire. When the boy is swimming leisurely across a river he is scarcely, if at all, conscious of the act of swimming (no more so than he would be under ordinary circumstances of the act of walking); he is only conscious of his wish to pick the water lilies near the further bank.

Instincts are well termed by Herbert Spencer inherited habits; and viewed in this way there is nothing particularly mysterious about most of them. Around some, however, our ignorance, or the limitation of our own powers, throws a halo of wonder. "A hound," for example, "was sent from Newbridge, county Dublin, to Moynalty, county Meath, and thence, long afterwards, conveyed to Dublin. The hound broke loose in Dublin, and the same morning made his way back to his old kennel at Newbridge, thus completing the third side of a triangle by a road he had never travelled in his life." This is but one instance out of many which might be quoted of an animal being guided by a sense of direction. But this sense is so undeveloped, or so very little developed in most of us, though it is possessed to some extent by North American Indians, and, as I am informed on good authority, by Kaffirs, that we are apt to regard it as

inexplicable on natural grounds. It may be, however, that M. Cyon's researches on the "semicircular canals," which he regards as the organs of this "sense of space," as he terms it, will throw more light on this subject.

But though instincts may be regarded as inherited habits, we must not suppose that they are in all cases habits intelligently acquired. On the other hand, I presume that in every case of instinct Natural Selection has been a more or less important factor. Or perhaps we may rather say that, with the aid of intelligence or without that aid, all instincts have been formed under the guidance of Natural Selection, such habits as were for the good of the species crystallising, or rather organising, into instincts; such as were detrimental quietly dying out. Or, again, we may say that these insects have been formed under the more general influence of the uniformity of Nature. Let me not be misunderstood here. The *conception* of the uniformity of Nature is one of late development, and is obviously impossible to the animal under any circumstances; but the *influence* of the uniformity of Nature is dominant in every mental, as it is in every physical, process,—mind being throughout its development moulded in conformity with an orderly external sequence of events.

In an animal which has been so long under domestication as the dog, instincts originally acquired under the guidance of Natural Selection may be more or less completely replaced by instincts formed under the guidance of Artificial Selection. Pointing, retrieving, shepherding, may be said to be instinctive in certain breeds of dog. These actions have not now to be learnt. They come natural to the dogs. And they are not only different from, but they are diametrically opposed to, the natural instincts of the canine race.

This modifiability of instinct by artificial selection is a fact of the highest importance. It means nothing less than the alteration of the whole character. The sheep-dog, whose ancestral instincts would prompt him to single out a sheep and pull it down, finds his pleasure in guarding the flock and keeping it together. What was before pleasurable becomes distasteful; pleasure is associated with an altogether new mode of action. For pleasure and pain are the normal incentives to action; and the whole complex process of Evolution has been accompanied by the association of pleasure with such actions as tended to the preservation of the individual and the race, and the association of pain with such actions as were harmful to the

individual or the race. It is only in this way that Evolution could be furthered by individual action. Without this association of pleasure with right action, and of pain with wrong action, the Natural Selection of conscious creatures would be impossible. There is a natural selection of *structures* and a natural selection of *actions*. The two must proceed in harmony; and they must be studied side by side. Every structure is or has been *of use*. It has been developed for the furtherance of right action. But right action, if it is to be persisted in by a conscious creature, must be associated directly or indirectly with pleasurable feelings. Nay more, if it is to be persistently persevered in, its non-performance must be associated with that dull form of pain which we call dissatisfaction. Only under these conditions can that form of conduct which leads to the survival of the individual and the race be evolved. The principle of greatest happiness has its roots firmly imbedded in the evolution of conduct throughout the whole realm of conscious existence.

We may say, then, with regard to the mental processes of the dog, so far as we have at present considered or glanced at them, that, first, there are a number of unconscious reflex actions connected with the maintenance of bare life which can only be called mental in the most extended use of that word; that, secondly, there are processes hardly, if at all, to be separated from reflex action, which are performed, perhaps unconsciously, immediately after birth, such as the processes connected with the instinctive act of sucking, &c.; that, thirdly, there are processes which have not to be specially learnt, but come natural at a certain age, such as the act of swimming and the instincts connected with the maintenance of the species, these being evolved under the guidance of Natural Selection; that, fourthly, there are the instinctive habits of pointing, retrieving, and so forth, which also come natural to certain breeds, and which have been evolved under the guidance of Human Selection, whereby a radical change of dog-character has been produced.

(To be continued.)

IX. AN AMERICAN VIEW OF THE VIVISECTION QUESTION.

THE book we take as the basis of our remarks, originally published in England, is one of several recent signs that British physiologists are at last coming to their senses, and, instead of attempting to conceal the fact that they experiment on animals, have decided to explain to the general public what a vivisection is, and why vivisections are necessary. Philanthropos, who is evidently well informed, discusses without passion or prejudice such topics as "What is pain?" "What is cruelty?" "Our rights over animals," "What is vivisection?" "The relation of experiment to physiology," "The relation of medicine to experiment," and so forth. If our colleagues across the water had, some seven or eight years ago, shown sufficient courage to trust to the common sense of the majority of their countrymen, and had endeavoured to inform the laity by securing the publication and distribution of some such book as this, the anti-vivisection legislation could hardly have been enacted. Its passage, and the still-continued agitation for an Act of Parliament totally forbidding all experiment on living animals, prove that the public did not and does not know enough about the matter to save itself from being misled by the reckless misstatements of irresponsible fanatics, and of certain seekers after notoriety or salary.

People in general do not read official blue-books; so, in spite of the fact that the Royal Commisaion appointed to investigate the matter reported that, after prolonged and careful inquiry, it could find no evidence that English physiologists were guilty of cruelty, it has been possible for certain anti-vivisectors, by a persistent course of malignant vituperation and brazen mendacity, to produce a wide-spread belief that vivisection essentially consists in torturing an animal for the object of seeing how much it can suffer without dying. That such is the actual conviction of many worthy men and women in England we know to be the case. The physiologists kept silent, and left the field to their enemies, with disastrous result; no one, not a brute, who believed half the stories circulated, could fail to hate physiology and physiologists. When the railroad stations of

England were placarded with large figures of dissections of dead animals, accompanied by printed words designed to entrap the general public into the belief that they represented vivisections of living creatures; when a text-book of practical physiology, designed only for special students of physiology, was represented far and wide as intended for use by every crude medical student; when the fact that the words "first gave an anæsthetic" were omitted (as they are in text-books of surgery, the administration of an anæsthetic being, of course, assumed in cases where very special reasons for its omission do not exist) in the directions for the performance of certain operations, was used as proof that physiologists never thought of employing means to prevent or minimise pain; when a law was passed which allows any one to torture a frog in the most brutal manner if he says he does it just because he likes it, but subjects a university professor to fine and imprisonment if he draws a drop of blood from the animal's toe for a scientific purpose,—then it had certainly become time for the physicians and physiologists of the British Isles to endeavour to inform the public on the vivisection question.

The anti-vivisection craze has now spread to Germany, and there are premonitory symptoms in the United States. Our people in general are too well informed, and have too great confidence in scientific men, to be so easily led astray as the English have been. We shall, moreover, be free from the pressure of a royal court which dislikes biological science, and from the influence of the personal prejudices of the sovereign, still powerful enough in England to have much weight in legislation on questions outside of Whig and Tory politics. Still, American physiology is by no means secure, unless its leaders take warning by the English disaster. They have, in consequence of British legislation, an opportunity to make the United States the chief seat of physiological research among the English-speaking peoples; and it will be a lasting disgrace to them if they let it slip. If, while freely admitting that they believe it their duty to experiment on living animals, they will be on the alert to correct at once the falsehoods and exaggerations of the fanatics; to take pains to teach the public how much the scientific treatment of disease depends on physiological, therapeutical, and pathological research; and to make it widely known how very small a percentage of vivisections involve more pain than that felt by a man on receiving a hypodermic of morphia,—then there is little doubt they will be allowed to carry on without hindrance their beneficent

work. The only danger lies in the ignorance of the great majority of ordinarily well-informed people regarding such subjects. Secrecy, not publicity, is what American physiology has to fear.

[We have great pleasure in placing before our readers the above remarks on the Bestiarian movement, made by our distinguished contemporary "Science," by way of a review of the work of "Philanthropos." See pp. 350 and 411 of our present volume.]

ANALYSES OF BOOKS.

Flowers and their Pedigrees. By GRANT ALLEN. London: Longmans and Co.

WE have here a reproduction of certain botanical essays—conceived under Evolutionist inspiration—which have appeared in various literary journals, and which have done no little towards popularising what may emphatically be called the New Natural History.

That the work before us is interesting and suggestive the author's name will be a sufficient guarantee. Nevertheless there are points brought forward upon which issue may not unfairly be joined.

In the first of the essays before us, the "Daisy's Pedigree," we find a very high claim put in for the great natural order of Compositæ. Says Mr. Allen, "It may perhaps at first hearing sound absurd to say that the daisy group, including these other Composites with tinted rays, forms the very head and crown of the vegetable creation, as man does in the animal creation, and yet it is none the less true. . . . If we take complexity and perfection in the adaptation of the organism to its surroundings as our gauge of comparative evolution, then the daisies must rank in the very first line of plant economy. . . . Thus from the strict biological point of view it becomes quite clear that the daisies, asters, chrysanthemums, and other rayed Composites with coloured outer florets, really stand to other plants in the same relation as man stands to other animals."

However, the author's mind is fortunately not entirely made up. On p. 150 he writes:—"Alike by their inferior ovary, their bilateral shape, their single stamen, their remarkable forms, their brilliant colours, and their occasional mimicry of insect life, the orchids show themselves to be by far the highest of the trinary flowers,—if not, indeed, *of the entire vegetable world.*" This is a different, and we must beg leave to add a much more satisfactory, doctrine. We are, of course, aware that human views of beauty or ugliness cannot be allowed to decide phytological rank. Yet when all due allowance has been made for the Dahlia, the *Zinnia*, the Cineraria, the Aster, &c., the Compositæ include so many uncomely forms—not forgetting that idol of our modern pseudo-æsthetic school, the sunflower—that we groan in spirit at seeing this order placed at the head of the vegetable world. Hence we cannot but rejoice to find the author, partially

at least, questioning the high rank which he has elsewhere claimed for the Compositæ.

In the essay on the Arum, or Cuckoo-pint, we find some statements which may require closer examination. We read:—"The Arum, however, has a still more cruel and insidious mode of procedure [no "cruel and insidious mode" having been previously mentioned]. Its berries are poisonous, and very often, I believe, they destroy the little birds that they have enticed by their delusive prettiness. Then the body of the murdered robin decays away, and forms a mouldering manure-heap from which the young cuckoo-pint derives a fresh store of nutriment. I will not positively assert that it is for this reason the cuckoo-pint has acquired its poisonous juices; but I cannot help saying that if any berry happened to show any tendency in such a direction, and so occasionally poisoned the creatures which eat it, it would thereby obtain an advantage in the struggle for existence, and would tend to increase the poisonous habit so far as it continued to obtain any further advantage by so doing. . . . It has been asked why the birds have not on their side learnt that the Arum is poisonous? The very question shows at once an ingrained inability to understand the working of natural selection. Every bird that eats Arum-berries gets poisoned, but the other birds do not hold a coroner's inquest upon its body, or inquire into the cause of death. Naturally the same bird never eats the berries twice."

Let us, however, even at the risk of being pronounced unable to "understand the working of natural selection," examine the above deliverances a little more closely. Does every bird that eats Arum-berries get poisoned, irrespective of the dose taken, of the other contents of its stomach, or of possible constitutional differences? In default of direct proof that such is the case, we must be permitted to doubt. We find that certain poisonous plants and certain animal matters are rejected as food by animals born and bred in the same district. How can this be except from a tradition—we can use no better term—that such substances are unwholesome? Nor need we wonder how such a tradition can arise. A bird plucks a certain berry; a beast browses certain sprays or twigs to a very small extent, and experiences more or less inconvenience. The knowledge of this fact is transmitted through the species, just as is that of other dangers, and the snare is in course of time avoided, however tempting the bait. It may, indeed, be asked whether "natural selection" does not at times furnish too easy an explanation for phenomena observed. We find a plant elaborating an intense poison. We are told that this is a defensive measure: the plant kills or makes ill such creatures as prey upon it, and their kindred gradually learn caution. Unless this were the case the protection derived from poisonous properties would be but slight. The Arum-berry developes a poison and assumes a brilliant colour that it may be

eaten, and with fatal effect. Certain caterpillars, reptiles, &c., having unwholesome properties, are gaily coloured for the very opposite purpose—that they may not be eaten. This subject is in need of a closer examination. Do any of our native birds ever eat the berries of the deadly nightshade, of the bryony, or of the bitter-sweet, and if so with what result? Are birds often found poisoned, save owing to human interference? There is here, we repeat, much room for study and some for experiment, though the latter must be performed in countries where the law has not been moulded to suit the whims of mænad novelists and honorary secretaries.

In two passages Mr. Allen puts on record his aversion to cultivated flowers. Thus he says, "To a botanical eye double flowers, however large and fine, are never really beautiful, because they lack the order and symmetry which appear so conspicuously in the five petals, the clustered stamens, and the regular stigmas of the natural form."

If this is a good and sufficient reason we can only express ourselves devoutly thankful that we have not a "botanical eye." We have seen it elsewhere "ruled"—we think by Mr. Allen—that double flowers cannot be beautiful because they are purposeless. If this canon is to be adopted mankind are greatly to blame for admiring a sunset sky. To what end is all its splendour? As far as we can perceive, a canopy of hodden-grey—such as we too often see—would have answered the very same purposes which follow from a western heaven where day "dies like the dolphin."

One very valuable lesson may be learnt from the book before us,—the low character and standing of yellow flowers. We hope that the neo-æsthetics may be induced to reconsider their love for the sunflower, the daffodil, and the buttercup.

The Standard of Value. By W. L. Jordan, F.R.G.S. Third Edition. London: David Bogue.

The author of this treatise contends that "the double standard of gold and silver was practically the standard of value throughout the civilised world from time immemorial to the year 1873." He asserts that the enormous national debts now existing have been borrowed under that double standard; and for the Governments of the world to legislate in such a manner as to establish a gold standard instead of that double standard constitutes the most gigantic injustice towards the labouring classes who are burdened with those debts that has ever been recorded. If Parliament in 1816 had the right to decree the legal establishment

of the gold standard, just after our immense debt of £850,000,000 had been borrowed under the legal existence of the double standard, then a future Parliament, returned by the debtors, who number 10 or 20 to 1 as compared with the creditors, will have an equal right to decree the legal establishment of a silver, a copper, or a paper standard, and thus to make our debt of little value to the holders. For if Parliament has a right to change the standard in such a manner as to *increase* the value of the debt 20 per cent, then it has also a right to change the standard in such a manner as to decrease the value 20 per cent.

Having thus briefly stated the author's views we must decline their discussion as scarcely possible without straying into questions which lie outside our cognizance.

Annual Report of the Board of Regents of the Smithsonian Institution. Showing the Operations, Expenditures, and Condition of the Institution for the year 1881. Washington: Government Printing-Office. 1883.

THIS volume comprises, in addition to the routine proceedings of the Smithsonian Institution, which is in a flourishing condition, a summary of scientific progress for the year 1881.

This survey, appearing so long after its date, will of course have lost some part of its interest, as most of the facts herein recorded have become known to the public through other channels.

The relative amounts of space given to the different sciences is worth notice. To Physics are allotted 46 pages; to Chemistry, 9; whilst Meteorology receives 100 pages, and Anthropology 197.

The predominant space thus allotted to a subject incapable—in the ordinary sense of the term—of "practical application," shows that there must exist in the United States an increasing appreciation for scientific truth, *as such*, and independent of its possible market value.

Zoology receives 91 pages, and of the 17 pages devoted to Botany a portion treats of the researches of Pasteur and others on diseases due to bacteria.

The new National Museum approaches completion, and before this time must have received the collections to be lodged in it, and have undergone the test of actual experience as to the suitability for the purpose intended. The great practical point—at least as far as zoological and botanical collections, and many geological specimens, are concerned—is freedom from damp. We are therefore somewhat startled at reading, in the Report of

the Building Commission, that "the patentee of an apparatus for moistening air by means of a system of aspirators, whereby it is claimed that in hot weather a reduction of temperature of eight or ten degrees can be accomplished, has offered to apply his invention to the new building." We should think that in a museum a reduction of summer temperature would be dearly purchased if attended with an increase of moisture. We can only hope that the great Washington Museum may not experience any mishap like that which has occurred at Geneva.

The Artists' Table of Pigments. Showing their Composition, Conditions of Permanency, Non-permanency, and Adulterations, Effects in Combination with other Pigments and Vehicles, and giving the most reliable Tests for Purity. By H. C. STANDAGE. London: Wells, Gardner, Darton, and Co.

WE have here a set of tables which will be exceedingly useful to artists, decorators, and to the manufacturers of paper-hangings. The common names, chemical names and composition, conditions of permanency and non-permanency, possible adulterations, nature of impurities and tests for their detection, are given in parallel columns, with the addition of useful remarks not coming under any of the above-mentioned heads. We regret to find that the chrome-greens are counterfeited by or adulterated with a mixture of chrome-yellow and Prussian blue. Such sophisticated or spurious chrome-greens are not only liable to be attacked and blackened by sulphuretted hydrogen, but are from a sanitary point of view less trustworthy than the genuine greens.

Extract of coffee-berries—*i.e.*, caffeo-viridic acid—is mentioned as an adulterant for sap-green. For ordinary artistic or decorative purposes this addition is to be condemned; but as a colour for the use of confectioners, for staining toys for young children, &c., the coffee-green, being perfectly harmless, is preferable to the buckthorn extract, which is a dangerous irritant.

The synonymy of the green pigments would admit of amendment. Thus there is no mention of Paris green, one of the arsenical copper colours. The looseness of the nomenclature of pigments employed by dealers is even worse than we supposed. Thus we learn from the tables before us that ordinary Brunswick green is made of a mixture of chrome-yellow (chromate of lead) and Prussian blue.

Under "Cœruleum, Cerulian, or Egyptian Blue" we notice an oversight. It is said that this pigment is a "silicate of *cobalt*," and then that it is "artificially made of carbonate of

soda, powdered flints, and copper,"—which mixture would, of course, yield a silicate of copper.

Among the adulterations of ultramarine, sugar might have been mentioned as added by some Austrian manufacturers.

Concerning Persian red we are unable to agree with the author. He describes it as a chromate of lead, or in other case a red obtained from ochres. We have always heard the names Persian red, mineral lake, pink colour, and lacque minérale applied to stannates of chrome, the preparation of which may be found in Gentele, and which are much more permanent than the chromates of lead.

"Crimson lake," we read, "is an extract from the *Coccus cacti* insect fixed to oxide of iron or alumina." An almost infinitesimal quantity of oxide of iron is enough to destroy the beauty either of the cochineal or the madder-lakes.

A few typographical errors may be pointed out for rectification in a future edition. Thus in one passage we find "cromate" of potash for chromate; elsewhere "*patassic*" nitrate for potassic; "Jeune" minérale for Jaune, &c.

In some cases also the author makes use of expressions liable to occasion misunderstanding. Thus he states that "Iodine Scarlet" is composed of 200 *equivalents* of mercury and 254 *equivalents* of iodine." "Parts" would be the correct expression, the word used giving a quite erroneous notion of the composition of the pigment.

As a whole, however, we consider that these tables will prove of great value. The price at which they are offered is remarkably low, so as to bring them within the reach of all persons interested in the practical application of pigments.

The Mason College Magazine. Vol. I., No. 8. November, 1883. Birmingham: Cornish Bros.

THIS little monthly goes on presenting its readers with not a little matter suggestive of wholesome thought.

We first notice an able paper on the "Study of Modern Languages." The author remarks that "we may claim for linguistic studies that they teach us to know ourselves nationally; to distinguish between the nation of philosophers, the nation of 'bels esprits,' and the nation whose devotion to the industrial arts has won for it the name of a 'nation of shopkeepers.'" It might be added that this sneer comes with scant grace either from the philosophers or the bels esprits, since they have developed such a vehement desire to insinuate themselves behind our counter.

Among the proceedings at the Mason College Union a memoir on the Phrenology of Gall must not be overlooked. The essayist, Mr. Barwise, brought forward some very strong points against that localisation of the mental faculties which some forty years ago had so many adherents. He remarked that little men with big heads are generally the most intellectual. This reminds us of the Byronian couplet:—

> "Tall men are oft like houses that are tall,
> The upper rooms worst furnished are of all."

We doubt, however, whether the intellectual superiority of little men could be demonstrated statistically.

On another occasion Mr. Greatheed moved the resolution, ultra-heretical in the latitude of Birmingham, that "compulsory education is an obstacle to individual development." As a matter of course he was defeated by a large majority. It may, indeed, be asked whether the suppression of individuality towards which we are hastening, in imitation of the Chinese, is due to the mere fact that education is compulsory, or to other of its features,—to wit, its examinationism and its "standardism." We utterly protest against the assertion of Mr. Ledsam, that "as to the upper classes examinations are beneficial unless the student crams." Mr. Greatheed's views, in our opinion, deserve to be reproduced before a wider public and to be carefully considered.

"Vox Clamantis in Deserto" writes concerning the wild speculations of Mr. George and his followers. "Vox" overlooks, however, the wildest:—"That the earth could maintain a thousand billions of people as easily as a thousand millions is a necessary deduction from the manifest truth that, at least so far as our agency is concerned, matter is eternal, and force must for ever continue to act." Matter may be eternal, but it is not infinite in quantity. We venture to say that there is not in our globe combined nitrogen enough for the bodies of a thousand billion human beings, and at the same time for the animals and plants upon which they must feed, and for the various animal and vegetable parasites which, so far, we have not been able to take even the first step towards extirpating. Before the earth maintains one billion of people in any other state than chronic misery, we must be able to form ammonia on remunerative terms from the nitrogen of the atmosphere, to control the weather, and to exterminate rats, mice, locusts, house-flies, the *Phylloxera*, the *Pteronospora*, the *Hemileia*, and a host of our animal and vegetable rivals in the strife for food. These points, if ever effected, will be due to the quiet labours of the physicist, the chemist, and the biologist, and not to the political agitator.

The Botanic Stand, a Means of Agreeable Instruction in the Knowledge of the Natural Orders of Plants. By THOMAS TWINING. London: David Bogue.

AMONG all *bona fide* teachers of Natural Science—*i.e.*, such as aim at something higher than "preparing" their pupils for an examination—the conviction is fast spreading that instruction should begin with and be based upon things, books being merely referred to secondarily for co-ordinating the knowledge gained in actual practice.

As far as Botany is concerned this method of study is made readily practicable by the suggestion given by Mr. Twining in the pamphlet before us. "The Botanic Stand" is simply a miniature botanic garden. Plants typifying the natural orders are set in flower-pots, and placed along a stand, stage, or shelf, at a height from the ground most convenient for inspection. The last words explain the advantage of this plan as compared with series of plants set in the ground. To examine the latter and watch the development of their characteristics it is necessary either to break off portions or to indulge in prostrations which, especially for ladies, are often neither pleasant nor salutary. By Mr. Twining's scheme, which when once proposed is simple as the traditional egg of Columbus, the student may gain a more intimate acquaintance with plants than from any amount of book-study, even if occasionally aided by reference to dried specimens. The "Stand" is an inexpensive affair, and might, we think, be adopted with much advantage in all schools where Botany is taught. For the details of construction and arrangement we must refer to the pamphlet.

Transactions and Proceedings of the Royal Society of Victoria. Vol. XIX. Issued May 10th, 1883. Melbourne: Mason, Firth, and Co. London: Williams and Norgate.

THE Anniversary Address of the President, Mr. R. L. J. Ellery, F.R.S., the Government Astronomer, contains a few points worthy of notice. Foremost stands the recognition of the priority of Mr. W. Thomson, of South Yarra, as the discoverer of the microbic character of pulmonary consumption. Mr. Thomson's pamphlet was published as early as 1876.

The evil effects produced by the destruction of the forests are recapitulated in the plainest matter. On this point, more than on any other, the future of Australia must hinge.

The Museum at the University is reported as being in an excellent condition; specimens mounted more than twenty years ago still appear quite fresh, owing to the purity of the air.

Among the memoirs inserted in the "Transactions" we notice one, by Mr. James Stirling, on the "Phanerogamous Plants of the Mitta Mitta Source Basin, and their Habitats." The author considers meteorological conditions as exercising a more dominating influence over the growth of plants and in the evolution of varieties than has hitherto been recognised. Whether the chemical variation of soils tends to evolve species is, he thinks, doubtful. On the effects of insect cross-fertilisation he cannot venture an opinion, but suggests that entomological agencies must be subordinated to climatic influences.

Mr. W. Mitten contributes a "Catalogue of Australian Mosses," very valuable for reference.

Dr. Jameson discusses the "Influence of Light on the Development of Bacteria," and concludes that it has little direct influence either in promoting or preventing the growth and multiplication of microbia.

Mr. P. H. MacGillivray contributes a "Description of New or Little-known Polyzoa," which is divided into three portions.

The Rev. J. E. Tenison-Woods, F.L.S., gives a very interesting physical description of the Island of Tasmania.

The Science Monthly. Vol. I., November, 1883. London: D. Bogue and E. W. Allen.

If the number of scientific periodicals may be taken as an indication the public interest in Science, or at least in scientific reading, must be on the increase. Compared with existing journals the "Science Monthly" makes the nearest approach to "Knowledge," both in the subjects embraced and in the general style of treatment.

The principal articles in the present issue are—"The November Star-Shower"; a notice of "Historical Floods," in which a paradoxical attempt is made to show that our climate has improved; "How the Teeth are set on Edge," a study of a common and unpleasant phenomenon not as yet thoroughly understood; "Insect Depredators," a *resumé* of the observations of Miss E. A. Ormerod and others. "Forestry at Home and Abroad" is a brief exposition of the mischief resulting from reckless denudation and of the present modes of forest management. "Weather Lore" is a notice of modern meteorological forecasts, in which some degree of justice is done to those popular empirical rules which we, in these instrument-loving days,

are apt to fling aside as mere superstitions. Under the head "Leaders of Science" appears a biographical notice of Sir G. Airy, late Astronomer Royal.

So far we can speak of the contents of this new journal with approval. But under the head "Table Talk" we find, with profound regret, an expression of sympathy with the Bestiarian —*alias* "Anti-Vivisection"—movement. It is painful to see a scientific organ thus aiding and abetting the latest phase of the persecution of Science, and allowing itself to be gulled by the misrepresentations of ignorant and interested persons.

In the "Contributors' Column" is an article on the "Natural Food of Man," which we notice elsewhere, and a letter on that ill-understood pest of Lapland the *Furia infernalis* of Linnæus.

Longman's Magazine. November, 1883. London: Longmans and Co.

This issue contains a paper by R. S. Ball, Astronomer Royal for Ireland, on the "Relation of Darwinism to other Branches of Science." We doubt if it has ever been our lot to meet with so clear and compact an exposition of the principles and foundations of Evolutionism as is given in this essay. The author shows how far the question of the origin of life is from being decided by the negative results of Pasteur and Tyndall.

Dio Lewis's Monthly. Vol. I., No. 3, October, 1883. New York: F. Seaman.

We have here a magazine devoted, it would seem, to philanthropy, hygiene, and kindred subjects. Hence drainage, diet, beer, and nursing are discussed, but the main cause of modern debility, over-work, escapes notice.

In the opening article, "Our Rich Men," we find what to us appears a singular error. To prevent the dangers to the community (real or supposed) arising from the existence of the millionaire, the writer says—"It would be wise as a precautionary measure to keep our eye on the youngsters, and when we find one with a large brain and keen eye, kill him. A standing committee to watch the schools for such boys would be a good practical measure. If you let them live they are almost sure to achieve some provoking success. A still wiser measure would

be a monster petition to the Creator praying that all such big-brained, keen-eyed, ingenious, plucky chaps be prevented altogether. If they are allowed to appear among us they are almost sure to make trouble. Some of them will turn out Vanderbilts and Goulds."

Now here, surely, we have the vulgar error that a man's intellect may be measured by his money, and that he who does not grow rich is a fool. Surely Dr. Dio Lewis must know that the big-brained, keen-eyed boy will crave to become a discoverer in Science, a creator in Literature or Art, and unless he inherits a competence is not unlikely to die poor, as many men of genius have done. If it were desirable to weed out from our schools the future plutocrats, the selectors would have to look out for boys of keen but narrow intellect and strong will, acting under the constant impulse of greed.

In an article on the "Treatment of Prisoners" the writer seems to leave out of view the great principle of heredity, and the impossibility of ascertaining whether a criminal is really reclaimed or is merely "biding his time."

Wilford's Microcosm: a Religio-Scientific Monthly, devoted to the Discoveries, Theories, and Investigations of Modern Science in their bearing upon the Religious Thought of the Age, with other Matters of General Interest. Vol. III., No. 3. New York: Hall and Co.

THIS journal declares itself Anti-Evolutionist and Bestiarian, and is consequently, *pro tanto*, outside the scope of our sympathies. It recognises "Realism or Substantialism," and speaks of the nebulous realms of Idealism." Its chief energies seem to be directed against the undulatory theory of sound, and we should infer of light also. The list of contributors includes no writers of any scientific standing, but in return is rich in "Rev. Professors," "Elders," &c.

Not being specialists in Acoustics, we find here nothing worthy of notice.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

THE IMMUNITY CONFERRED BY AN ATTACK OF CERTAIN CONTAGIOUS DISEASES.

To the Editor of the Journal of Science.

SIR,—Allow me to call your attention to a coincidence. In the "Mason College Magazine" for October, published at the beginning of that month, a correspondent who signs himself "X. Y. Z." writes as follows:—"It seems to be, though I am probably uttering a mere truism, long recognised by all acquainted with the subject, that the germ theory gives a clue to the puzzle. The principle seems to be that of the rotation of crops. When the smallpox or vaccine germs are planted in the human body, they, as it were, exhaust the soil by withdrawing from it the special nutriment which they and their kind require. Until the element withdrawn is renewed, which may happen sooner in some constitutions than in others, the patient is not liable to a return of the disease."

In the "Pall Mall Gazette" for October 30th Professor John Tyndall says:—"He (Sir Thomas Watson) once asked me how I supposed the immunity just referred to was to be accounted for? I acknowledged the difficulty, but stated at the same time that the germ theory came nearest to a satisfactory solution. A certain amount of mineral matter was known to be necessary to the constitution of a tree. Without it the tree could not grow, although in comparison with the other constituents of the wood its quantity might be infinitesimal. The exhaustion of a soil often meant the removal from it of a minute but necessary constituent. Reasoning from analogy I ventured to express the opinion that the rarity of second attacks of communicable disease was due to the removal from the system, by the first parasitic crop, of some ingredient necessary to the growth and propagation of the parasite."

Here, surely, is a most curious coincidence.—I am, &c.,

O. P. Q.

WE ARE.

To the Editor of the Journal of Science.

SIR,—It is interesting, at any rate, if not instructive, to look back in history, and see what old fellows who have been dust for centuries used to think on questions that occupy us to-day. L. Botero, a philosopher who flourished as a Jesuit in Elizabeth's reign, looked on the increase of the human species as hindered by the indifference of the State. Now-a-day the question seems more to be, how is it to be kept down on a level with the national wealth? Hallam quotes him to the following effect:—"No encouragement to matrimony, he observes, will increase the numbers of the people without providing also the means of subsistence, and without due care for breeding children up. If this be wanting they either die prematurely or grow up of little service to their country. Why else did the human race reach, three thousand years ago, as great a population as there exists at present? Cities begin with a few inhabitants, increase to a certain point, but do not pass it, as we see at Rome, at Naples, and in other places. Even if all the monks and nuns (!) were to marry there would not, he thinks, be more people in the world than there are; two things being requisite for their increase,—generation and education (or what we should perhaps rather call rearing); and if the multiplication of marriages may promote the one, it certainly hinders the other." Meaning, Hallam concludes, that the poverty attending improvident marriages is the great impediment to rearing their progeny.

Though we are apt selfishly to consider it a blessing there are not more, yet we cannot fail to feel a force in the simple remark of a good old soul:—"Never fear how many children ye bring; the Lord 'll find means for 'em all." Though the human race may outgrow vegetation, it cannot outgrow its own wit.

The vices of humanity have acted perhaps more beneficially to us than we are apt to think. How long is it since the first man died a slave? We cannot tell; nor does any prettily arranged chronological table affect us. Just so long, then, has not the humiliation of man's mind been born, bold aspirations checked, free choice turned to submissive waiting, equality debased to servile worship, sacred feelings outraged and crushed for centuries until they were all but forgotten,—these, and a thousand more, have they not had their effect? Who is to say that much of reverence—our religion—is not the outcome of Slavery? Slaves are not separate beings: it is needless to enumerate how they mix their blood with their "superiors," and idle to show how

man attributes debasing actions to the offspring of slaves or inferiors. There is an old pathetic song that has it :—

> "They say I cannot love
> Because I am a slave!"

War has certainly been a blessing in disguise for ages back. Then, again, Vice begets Immorality, and she is the mother of fewer children than her purer sister. Vice actually keeps down the populations of cities. Why does the political economist omit her from his unproductive persons? Is she not productive in selfish good to the "greatest number"? A former article in your Journal has shown how obligingly useful she is to rid us of our weak-brained competitors in life's struggle: the pity is she is allowed to permeate her rottenness, through Act of Parliament, through the system of every offenceless babe. It is a false sentiment that has any pity for the morally and physically debased. We are too apt to creep as in a dark, strange road, with a wretched lamp. There have been political revolutions and religious revolutions, but no moral revolutions. We allow our laws to make illegitimates and harlots, because the world does so; we continue to force upon our unwilling intellect (and it must have its effect) the fossil ideas of our grandfathers. Both of us may be right; it is a stable that needs a Hercules, only the dung is the landmarks of centuries here. The useless man is voted in the way, and yet the diseased is allowed to marry, the criminal is allowed to breed; and these sons of Cain will wed with the daughters of Seths, and leave us all in a glorious muddle of degeneracy and decay.—I am, &c.,

D. Y. Cliff.

THE BRITISH ASSOCIATION AND THE ENDOWMENT OF RESEARCH.

To the Editor of the Journal of Science.

Sir,—In the Report of the Committee beginning with the "Facial Characteristics of the Races and Principal Crosses in the British Isles," it would seem that that of the Gipsies with native blood has not been included. As regards the "Picts, Angles, and Jutes," it may be said that the impression made by them on the population at large has been confined to the appearance and certain peculiarities of such as possess their blood, as would be shown in the crossing of domestic animals. But when

these would become scattered through the population every internal trait of the connexion would be lost, while none of the peculiarities, or none of consequence, would consciously survive, where they lived in a body, beyond some of the ways, folk-lore, or superstitions of the humblest classes of the community. With the Gipsies the case is altogether different, for the reason that they entered Great Britain not later than 1506, and were legally and socially proscribed, and have never been recognised by society in any way. As a migratory, tented, oriental tribe, that exists everywhere, they had, and have yet, a language and signs, and a cast of mind or a soul of nationality peculiar to themselves, with a sympathy, more or less modified, for the same people in every part of the world. The feelings peculiar to the primitive Gipsy are held by the offshoots from the tent, however much the blood is mixed, or improved by the circumstances applying to the ordinary population. As illustrative of this fact we find that Mrs. Carlyle, who was "one of them," was indifferent to her *native* connexion, as fully admitted by Carlyle. The subject of the "Picts, Angles, and Jutes" may be called "dead anthropology," while that of the Gipsies, in all its bearings, is "ethnology on its legs," embracing a large body of people, in many positions in life, existing in the British Islands (as well as in other countries), unacknowledged by the rest of the population. These the British Association seems to have ignored.

With reference to Prof. Ray Lankester's proposal for the "Endowment of Research" I said, in my "Contributions to Natural History, &c.," that original research is "almost invariably, for a time at least, abased or refused the slightest courtesy when something has to give place to what is brought forward" (p. 199); and that Prof. Huxley, when at Baltimore, in September, 1876, "while discouraging the vulgar expedient of offering money for it, said nothing of extending to it the courtesy of discussion through the ordinary channels, doubtless for the reason that that aspect of the question was not specially before the meeting" (p. 200). There are many difficulties attending the "Endowment of Research," under whatever form it might be done; but there should be none in the way of admitting research that has been made by the labour and at the expense of people individually. In that respect zoologists should admit the existence of the research into the question stated by White of Selborne, whether the viper (in common with some other snakes) "opens her mouth and admits her helpless young down her throat on sudden surprises."—I am, &c.,

JAMES SIMSON.

New York, November 9, 1883.

NOTES.

"GABRIEL MAX's latest painting is at present on view at Munich, where 'The Vivisector' forms one of the chief attractions of the exhibition at the Odéon. The picture is said to be a marvel of technical execution, but the whole scene appears to be planned in order to startle and to create a sensation, which, like the artist's former works, it does not fail to do."

(It appears that every man in Art, as well as in Literature, who takes his stand upon falsehood must now lift up his heels against physiological experimentation.)

Dr. B. Grassi has at last furnished a complete demonstration that the common house-fly is a great agent in the spread of disease. We have long entertained this view, and have proposed general action for their destruction.

F. W. Parker, Principal of the Cook County Normal School, Illinois, believes that examinations are the greatest curse that schools have.

According to M. Deperet ("Comptes Rendus"), in the Upper Miocene of Pikermi antelopes predominate among the ruminants; the Cervidæ are rare, and the Bovidæ have not yet made their appearance. In the Pliocene of Perrier the antelopes become rare, the Cervidæ are richly developed, and the Bovidæ make their first appearance in Europe.

M. F. van Assche ("Comptes Rendus"), by passing light through a thin film of selenium, succeeds in completely isolating the thermic from the chemical and the luminous undulations.

Science sometimes gets an undeserved compliment. We met lately with this dictum:—"I do not remember ever to have heard of a practical chemist who grew angry if rallied about his chemistry." Yet quite lately a controversy between two German professors of chemistry has ended in the Law-Courts.

It seems that a new Bestiarian organ is to appear, entitled the "Champion." It is to be written in two languages!

"Science" gives a very hostile notice of Prof. Sylvanus Thompson's work on the telephone of Reis. Mr. Barney, in the "Electrical Review," points out that "Science" is published by a company, of which A. Graham Bell is Vice-chairman, and his father-in-law, G. G. Hubbard, one of the Directors!

Dr. T. L. Phipson, writing in the "Chemical News," maintains that plants have no power of decomposing carbonic acid.

An Anti-Vaccination Congress has been held at Berne, under the presidency of M. H. Böens.

"Light" gives instances of the apparition of the spirit of a dog and of a horse, and describes a case where a cat saw and was much terrified at the ghost of a wicked old woman.

A member of the Paris Anthropological Society considered it "not happy" that an autopsy of the brain of the late L. Asseline had brought to light a simian feature.

According to the "American Naturalist" the Colorado beetle is decreasing in numbers in Pennsylvania.

Mr. J. C. Hughes ("Forest and Stream") remarks that the American wolf (*Canis lupus* var. *occidentalis*) feeds, to a large extent during summer, upon various berries, the seeds of which map be abundantly recognised in its excrements.

[This fact is one of many proving how the old arbitrary distinction between carnivorous and herbivorous or fructivorous animals is breaking down.]

The "American Naturalist" writes, somewhat strangely, "There is a duty which every scientific man owes to the community which supports or tolerates [!] him, a duty which becomes greater as his authority and influence are increased in his chosen field. That duty is to present in the vernacular of the people the leading facts in his chosen science." From this view we totally dissent.

The question of the permanence of existing continents and seas is still under discussion in the "Geological Magazine," Prof. Le Conte and S. B. J. Skertchley taking the affirmative side.

It is to be remarked that among Coleopterous insects longitudinal markings occur chiefly in the less highly developed groups, such as Curculionidæ, Longicornes, Chrysomelidæ, &c.

M. Baubigny ("Comptes Rendus") has determined the atomic weight of nickel as 29·372 (that of sulphur being taken as 16·037).

The election of a Lord Rector for Edinburgh University has again been conducted on political principles, Sir Stafford Northcote being the successful candidate.

We are somewhat surprised to find that Mr. A. R. Wallace has given in his adhesion to the Anti-Vaccinationists.

Tarchanoff ("Pflüger's Archiv.") shows that the egg-albumen of those birds whose young are featherless when hatched differs from normal albumen in several of its physical and chemical properties.

An esteemed medical contemporary is exceedingly severe upon the Psychical Research Society.

We copy the subjoined paragraph from the "Medical Press and Circular," as showing how "public opinion" is manufactured :—

"Mr. Jesse, who describes himself as 'Honorary Secretary, Society Abolition Vivisection,' has been fruitlessly wasting the proceeds of his constant appeal for funds in widespread publication of one of our recent notes from abroad in which the details of Biondi's experiments on ablation of the lungs are given. By a curious oversight which would scarcely have been expected in an official so ingenious as the 'Hon. Sec., &c.,' Mr. Jesse has let us into the secret of his endeavours to obtain weight. Within a few days no less than four separate slips of Mr. Jesse's advertisements of the 'Medical Press' have reached the office of that paper, each posted from a different town, the intention doubtless being to delude us into the idea that they were forwarded by indignant readers. But, alas! for the success of the plot, in all cases the extract has been forwarded as sent out by the printer *in proof slips*, Mr. Jesse having, in his hurry to overwhelm, forgotten to cut the edges round, and so ensure its being taken for a veritable newspaper cutting. We have been much amused by the proceeding, and while candidly admitting that we should equally as readily have penetrated any other little device of the kind, we yet offer the 'Society Abolition Vivisection' our sympathy in its failure to arouse more than good-humoured contempt of its weakness."

Judging from the current number of "Light" it would almost seem as if Spiritualism was beginning to make amicable approaches to Astrology and —— Mormonism!

We are inexpressibly disgusted at the following advertisement:—"Wanted, kingfishers, clean and fresh-killed; any quantity." We do not care to say what we wish for the advertiser, or for the paper which inserted his advertisement.

P. Blaserna "Accadem. dei Lincei") maintains that the temperature of the glacial epoch was not necessary, and that glaciers belong to a time when the average temperature of Europe was about 2° C. higher than the present.

A medical contemporary describes a poisoning case due to the consumption of tinned salmon. "The tin in which the fish had been imported was denuded of its inner covering in many places, nitrate of tin being formed." Whence the necessary nitric acid?

The French Commission of Inquiry on the permissibility of the use of salicylic acid in preserving articles of food has reported against the practice, the drug accumulating in the human system.

We learn that Dr. Tanner, known for his fasting performances, has been arrested for practising with a bogus diploma.

According to "Science" a disease similar to *Entomophthora muscæ* in the house-fly has attacked the locust, *Caloptenus differentialis*, and is proving widely fatal.

The "Kansas Review of Science" says, erringly, "Educated men, in Europe, all know the principles of art, its methods, and its schools."

Professor J. Lawrence Smith, the eminent chemist and mineralogist, died recently at his residence in Louisville.

Tellurium, nickel, and cobalt are said to occur in very large quantities in the State of Colorado.

At the Annual Meeting of the Birmingham Suburban Institute Union, Sir Stafford Northcote is reported to have said that he was not a little jealous to see the manner in which the younger sister science had been able to put aside the study of the elder sister literature." This utterance must seem strange when we reflect that Science has not won that independence and equality to which she is entitled, and that Literature, under the name of "general culture," is still forced, as it were, down the throats of those craving for a different diet.

Dr. G. Wyld has engaged in a controversy with the "Medical Press and Circular" on the subject of mind-reading.

At a meeting of pupil-teachers in Westminster, Archdeacon Farrar, whilst admitting the dangers of overwork connected with our present educational system, naïvely advised his hearers to "always endeavour to be cheerful."

On November 15th Professor Osborne Reynolds, F.R.S., delivered a Lecture on "The General Theory of Thermo-dynamics" before the Institution of Civil Engineers.

We learn, with disgust and indignation, that an outrage has been committed on the statue of Liebig, at Munich. The entire left side of the figure—and especially the head, shoulders, and hands—has been drenched with a dark-coloured liquid, which appears to penetrate into the marble.

We regret to put on record the death of Sir William Siemens. Discoverers and inventors die off, whilst speech-makers seem endowed with the longevity of their prototype, the raven.

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